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JOURNAL OF DAIRY SCIENCE

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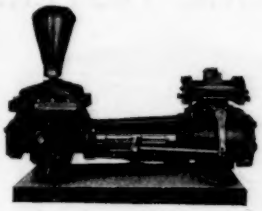

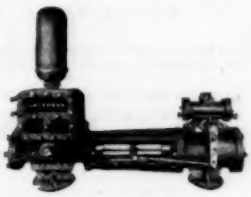

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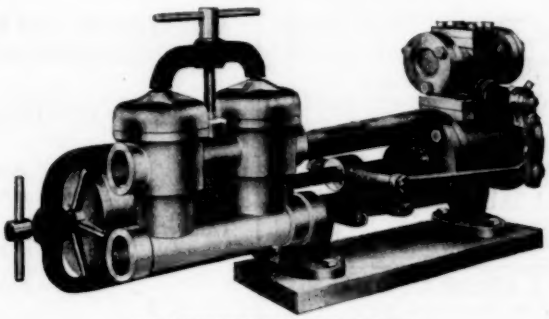

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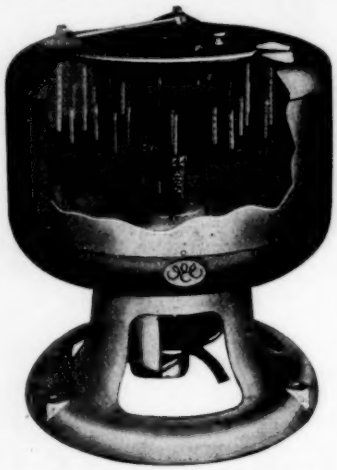

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PRESIDENTIAL ADDRESS[1]

C. H. ECKLES

St. Paul, Minnesota

This is the sixteenth meeting of the American Dairy Science Association. I believe this organization has performed a distinct service to the dairy industry of the United States.

The preamble of our constitution states that "The object of the association shall be to advance the general welfare of the dairy industry, especially, by the improvement of dairy instruction, the stimulation of scientific research, in all phases of the subject, and by improvement in methods of conducting extension work." I believe the organization has in a generous measure served this purpose in the past.

In my judgment there has been marked advances in every line of the several activities in which our members are engaged. Instruction in dairying was begun only about thirty years ago. At that time no one had any experience in teaching the subject. The inevitable result was that considerable time was required to get the subject into pedagogical form so it could be taught. This accounts for much of the inferior teaching we all know has been done along this line in the past and for the lack of uniformity which has been so noticeable in the past in the arrangement of our courses of instruction.

One of the marked advances during recent years has been the improvement in the college instruction along dairy lines resulting from a better understanding of what should be taught and how the teaching should be carried on. This improvement is certainly due to a considerable extent to the work of this organization, especially through the committee reports and discussions at our annual meetings. I feel confident that the instruction in

[1] Delivered at the opening session of the Sixteenth Annual Meeting of the American Dairy Science Association at St. Paul, Minnesota, October 11, 1921.

dairying has been improved in every institution in the country that has had a representative at one or more of our annual conferences. Not only does the information derived from our discussions and from conversations with those from other institutions widen our knowledge regarding methods of instruction but, perhaps greater than all, it supplies a stimulation for doing things better that cannot be fairly measured.

The college instructor in dairying has some serious problems still before him. With the rapid increase in attendance at all agricultural colleges the question of how to handle large numbers of students in laboratory work is becoming a serious one to practically every instructor in dairy work. Efficient instruction in dairy work requires abundant and expensive equipment, together with a large force of instructors in proportion to the students. It is recognized that the function of a dairy department in all agricultural colleges is not alone to give instruction in any limited field of dairy manufactures. No dairy department is complete without provision for instruction in all that pertains to dairy cattle, bacteriology of milk including sanitary market milk, and the manufacture of butter, cheese, condensed and powdered milk, and ice cream. Another problem is how much purely practical work a student in dairying should be given, and what part of his time should be devoted to securing a scientific training fundamental to the work for which he is preparing himself. In other words, is it the duty of a Dairy Department to turn out men qualified to immediately take hold of large business enterprises or is it our duty to give men a good fundamental training and expect they will gain most of their practical experience after leaving the institution?

The tendency of the public is to expect that our graduates shall be able immediately after leaving school to carry large responsibilities and as instructors we perhaps encourage this idea unduly. Why should we not look upon instruction in agriculture more as is done with the technical instruction in engineering? It is not expected that an engineer is competent to assume large responsibility immediately upon graduation, but that he has the fundamental training which makes it possible for him within a short time to carry such responsibility.

Another important question is that of more and better qualified men for college and experiment station positions. We are not turning out enough thoroughly prepared men. There should be more graduate students in dairy husbandry than is the case at present. The time is already here when a man to fill a first class college position and rank with other men with whom he is associated must have a good graduate course. I am glad to say that graduate students are now enrolled in some of our institutions working for a doctor's degree along dairy lines. I believe it is our duty to encourage this kind of work in the stronger institutions. I do not in any way minimize the importance of practical instruction, but at the same time I feel it is even more to the credit of the institution and more service to the state to turn out a few thoroughly qualified men who become leaders in their lines than it is to over emphasize the importance of turning out a graduate who can immediately turn his hand to practical work but whose training has been inadequate to enable him to do real constructive work of permanent value.

Another of the objects of this organization should be to stimulate research work. A few men in college work may gain prestige and be of great service to the state on account of executive ability, others through special attainments in the way of teaching, still others through their ability to disseminate information become leaders in extension work; for others of us perhaps the best opportunity to do something that will be of real value to the world at large and at the same time bring us some credit lies along the line of scientific investigation.

The research side of dairy husbandry work has certainly received great stimulation within recent years. There is unquestionably far more good work of this kind under way at the present time than has ever been the case at any one time in the past. I do not believe it is boasting to say that this organization has also been a considerable factor in bringing about this improvement. Anyone familiar with research work in dairy lines knows that in the past most of the best work has been done by men who were trained especially in some certain scientific line, as, for example, bacteriology or chemistry, and were not

primarily interested in technical dairying, and the same will probably be the case in the future. The man filling a dairy position has such varied responsibilities to carry, including the business management of a considerable business enterprise, teaching regular classes, and carrying on extension work, that he has little time for investigation. Further, his subject involves several distinct scientific lines, which adds to the difficulties from a research point of view.

There is no reason why the head of the dairy department in a college or a man filling a responsible government position should not, however, be a real leader or director of the most valuable and fundamental scientific work that may be done along dairy lines. He must not make the mistake of trying to do it alone. The time is past when it is possible for any one man to attack a problem of any size alone when it involves as widely separate lines as the feeding and management of the animal and the application of chemistry and bacteriology. Such investigation must be carried on largely by the association of men familiar with the various phases of the work. Practically nothing can be done in the way of research work relating to either dairy products or dairy cattle without the assistance of a chemist. Whenever research work involves the animal then we will sooner or later need the services not alone of a chemist but of a physiological chemist. It seems probeble that the most important results in connection with experiments involving animals within the next few years will be brought about by applying the principles of physiology and chemistry together with the knowledge of the expert in handling animals.

Dairy husbandry is the application of several sciences to certain practical lines and for this reason a man directing such work should have a rather broad training without being necessarily a specialist in any one. When a chemist alone undertakes to carry on an investigation with animals he is apt to overlook some of the essential points in treatment of the animals used and he is not in a position to know the problems that need solution from a practical standpoint. On the other hand one filling a responsible position along dairy lines does not have as a rule the intimate

knowledge of chemistry and especially of physiological chemistry necessary to properly carry on a research to a good advantage. The man in this position, however, has an opportunity to know the problems that the practical man wants solved and he should combine with this the technical knowledge of the management of the animals or the manufacture of the dairy products, as the case may be. The plan that must be followed in the future if we gain much headway is to work in groups. One of the group must have a broad general knowledge and be familiar with the practical side of the problem. Associated with him must be competent chemists, physiologists and bacteriologists according to the problem at hand.

The Dairy Division of the United States Department of Agriculture continues to fulfil its position of leadership. The United States government has always been the real leader in popular education in this country. The state universities were founded as the result of an act of Congress. Our agricultural colleges were established by the same body. Agricultural research was begun by the Hatch act establishing the experiment stations and later further stimulated by the Adams act. The Dairy Division through its wide dissemination of knowledge and its leadership in improving market milk, developing better methods in creamery work, assisting in the introduction of modern methods in the South, and taking the lead in encouraging fundamental research, is doing constructive work, the influence of which will still be felt in generations to come.

The object of the Dairy Science Association is not the dissemination of information regarding improved methods which is the function of other agencies. Our business is rather that of considering, as those in positions of responsibility, how we can best do our work, how we can best carry knowledge already known, to the public in general by extension work, and to our students by class work instruction, and how we can so direct our efforts as to make the most rapid advance in the acquisition of new knowledge.

The agricultural colleges and the United States Department of Agriculture have already obtained a position of leadership in

American agriculture. Each member of this Association bears a part of this responsibility. To a large extent we are depended upon by the industry which we represent to lead them in the right direction. We are either leading the people right or we are leading them wrong. The dairy industry already represents a value of nearly two billion dollars each year. Only two or three products of the farm exceed it in value. We also realize great responsibility of improving the conditions under which this enormous amount of human food is put upon the market to the end that it may not endanger health. The future development of the industry in which we are interested is to no small extent under our influence. It is our duty to help place the agriculture of America on a permanent basis.

If time would permit it might be profitable to enumerate some of the past achievements of the American Dairy Science Association. Important as these are there remain so many possibilities of usefulness before us that our attention should be directed mainly toward the future and its problems.

MEMBERSHIP

Our membership is now the largest in the history of the Association. Through the activities of our membership committee, a report from which will be presented for your consideration, over fifty new members have been added within the past two months. In making this campaign for enlarging our membership the aim has been to fully maintain the standards of our association as prescribed by our constitution. The question of how wide the door of membership should be opened, you will recall, has been the cause of considerable difference of opinion in the past. Membership in this organization was originally limited to men in college experiment station and extension work and in the United States Department of Agriculture. When our present constitution was adopted the organization was broadened somewhat and became in reality a professional association. This is not a business association, but a professional group corresponding somewhat to the bar association, medical associations and various chemical societies. Undoubtedly the eligibility re-

quirement as it now stands in the constitution should be clarified somewhat as it is too indefinite. A report of the committee on constitution and by-laws will be presented dealing with this subject.

I am strongly of the opinion that the door of membership is now open wide enough to admit all who will add strength to our Association. I see no special advantage in changing our basis of membership merely to increase our numbers. However, all who are properly qualified should be offered membership. I desire also to recommend a change in our method of increasing membership. At present we wait for candidates to apply and we urge them to apply for membership. It is decidedly unpleasant to reject a candidate who does apply under these conditions and presumably some do not apply who are eligible and who would like to be members, on account of uncertainty as to their eligibility.

A much more dignified and more business like plan would be to elect men to membership without formal application on their part, leaving it to them to accept the membership offered them or decline it as they see fit. To put our election of members on this basis would require some little activity on the part of the regular membership, to be sure, since it would devolve upon them to nominate members. It would also add somewhat to the burdens of the secretary. A plan of this kind carried out with the full coöperation of the members would bring in most of those who should be members and if the eligibility for membership is properly safeguarded would make election to membership mean much more than it does under our present procedure.

JOURNAL

The Journal of Dairy Science is a publication of which we may well be proud. I wish to commend the work of the editor most highly. Our Association is greatly indebted to Professor Frandsen for his services in this position. If our organization had never done anything else but establish this journal our efforts would be well repaid.

SECTION ORGANIZATION

In accordance with the constitution adopted two years ago the meeting held in October, 1920, took the first steps towards the organization of sections. Three were authorized by the executive committee as follows: (1) Dairy production; (2) dairy manufactures; (3) official testing. At the annual meeting of the Association of Extension Workers in Dairying it was voted to join the Dairy Science Association, constituting a dairy extension section. I am sure all welcome the addition of this important group as a section of the Dairy Science Association.

The section plan of meeting makes it possible for each important interest to have its full share of time for the presentation of reports and papers. Much remains to be done in the way of completing the details of the organization and getting a program for the future under way. Steps should be taken to classify the membership according to the section with which they wish to especially affiliate. Presumably many members will desire to retain their relations with more than one section and I see no objection to such an arrangement. For the administration of the work of both the sections and of the general association such lists are essential.

PROGRAM

In my judgment the most important step before the Association is the formulation of a more definite program for its activities in the future. The importance of this was clearly brought to our attention by the chairman of the dairy manufactures section in a recent number of the *Journal*. I trust the committee on organization for the sections will have something to present along this line.

Closely connected with this matter of a general program of work is that of the character of a program to be given at our annual meeting. I am not entirely satisfied with the character of the programs we have been accustomed to have on these occasions. Possibly we have depended too much, for one thing, upon committee reports. A certain number of committees are a very essential part of our organization and some construction

work of a high character has been done by them in the past. Standing committees to deal with certain subjects should unquestionably be maintained and most of these will do the best work if the membership remains fairly stable from year to year. Among committees of this type I would place those dealing with standards, score cards and judging contests. Committees of this class should not be expected necessarily to report at every meeting. They should remain on guard to study any situation that may develop and to report as often as it seems advisable.

There are committees of another type that should be relieved when the specific purpose for which they were appointed has been accomplished and their report has been submitted. In this class I would place such committees as those dealing with courses of study and feeding standards. If such committees are continued the membership should be changed from year to year. When a man has once given his ideas along a certain line he should not be called upon the next year to give to report again on the same subject. I am of the opinion that in many cases better results would be had if an individual member was asked to prepare a report or paper upon subject in place of appointing a committee of several members. This statement is clearly limited to subjects of a certain class. For example, one member could and probably would prepare a better report upon graduate instruction in dairy husbandry than a committee could. If a subject of this kind is in the hands of a committee the report, if it is forthcoming, must of necessity be almost exclusively the work of some one member of that committee. On the other hand where the subject matter is of another type combined action of a committee is clearly essential, for example in the case of standards and official testing.

I am not pleading for the abolishment of all committees but that they be rearranged with a view to deciding what standing committees are needed and what should be their responsibilities. All committee reports should be prepared in proper form for publication in the *Journal* and published later if deemed advisable by the board of editors. If the report is too long a résumé only should be presented at the session of the association.

Most other societies of a similar nature present a program either in the nature of scientific papers or addresses and reports by individual members. A common practice at scientific meetings is to have abstracts read of papers to be published in the journal of the society later. I believe this feature could be added to our program with advantage. I have no thought that it would be desirable to make the entire program of this character but to add it as one feature. My suggestion is that the program should be a combination of (a) reports of standing committees, (b) papers or reports by individuals who have been asked to make reports on particular subjects, (c) abstracts of scientific papers by members—these to be limited to five or eight minutes each with the understanding that the full paper be submitted for publication in the *Journal* later. It would seem logical to place the responsibility for the programs of the sections upon the officials of the sections, leaving the general officers the responsibility for the general program. Probably there should be a provision in the by-laws covering this point, although such provision is not found in the by-laws at present it was assumed to be the proper procedure and the responsibility for the assignment of the programs to be given by the sections today and tomorrow was definitely given to the chairman of the several section.

ORGANIZATIONS OF DIVISIONS

The constitution makes provision for the organization of divisions of the Association based upon geographical considerations. There has been for several years an organization including a group of men engaged in college, experiment station and extension work on the Pacific coast. The suggestion has been made to members of this group that their organization become a western section of the Dairy Science Association. I believe the matter has not been passed upon as yet by that group. A committee representing a similar organization in the eastern states will present a request today that an eastern division of the Association be authorized. This is entirely in accordance with our constitution and is a most desirable arrangement. While the

constitution places the authority for the authorization of sections and divisions with the executive committee, since the matter comes up for action at the time of our annual meeting it will be brought before the Association for action.

RECOMMENDATION OF THE EXECUTIVE COMMITTEE

The report of the secretary-treasurer shows the Association to be in a healthy condition financially. The income for the coming calendar year available for the uses of the association is estimated at $625, which in addition to our present balance on hand will make possible a forward step in the affairs of the organization.

The Association by action of its executive committee has appropriated since the *Journal* was established $100 yearly for the expense of the office of the editor. This sum falls far short even of paying clerical help and postage. This means the business of our association has been financed in part by the institution and later the company with which our editor has been associated. In addition our editor has donated his services. The only compensation he has ever asked has been the support of his colleagues and the proper appreciation of his efforts. In view of our present improved financial condition we recommend that beginning with the next calendar year the sum of $300 annually be appropriated for the use of the editor of the *Journal* in paying office expenses and advancing the interest of the *Journal* in whatever way he may find desirable.

The position of secretary calls for a large amount of detailed work as well as the contribution of much constructive thinking. The plans of our organization and our enlarged membership will result in even greater demands on the time of the secretary in the future. We have reached the point where the secretary should receive some compensation for his services and should have sufficient funds to pay the necessary office expenses. We recommend that the secretary receive a compensation of $100 for each calendar year, with an appropriation of $100 for office expenses with the understanding that additional sums may be used with the approval of the executive committee.

This action as recommended we feel is only a step in the direction in which we shall advance year by year until some time in the future we shall have a full time secretary and an editor receiving a salary in keeping with the position our *Journal* will have reached by that time.

Behind the activities we expect to have a membership adequate to properly support the organization and one whose leadership in the advancement of scientific dairy husbandry shall be unquestioned.

ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION[1]

GENERAL SESSION

The sixteenth annual meeting of the American Dairy Science Association was held in connection with the National Dairy Show at the Twin Cities, October 11, 1921. The meeting opened with an address by President Eckles, following which Professor Regan reported on the question of an eastern section of the Dairy Science Association. It was proposed that this section hold their annual meeting in connection with the Eastern States Exposition. It was moved by Dr. Harding that it be the sense of this meeting that we favor the formation of an eastern section, the geographical location of which shall be determined by the executive committee. This motion was carried.

A letter from Professor Hastings was read regarding the representation of our Association on the National Research Council. Moved by Professor Stocking that this matter be taken up by the executive committee with the Council, looking toward a representation of this organization. Motion carried.

The report of the secretary showed that the Association is in very good financial condition.

After a brief discussion of the secretary's report, it was the opinion of the Association that some funds, placed at the disposal of the secretary and the editor, would enable them to more rapidly advance the interests of the Association.

It was moved by Professor Davis that the recommendation of the executive committee be approved and the following budget be adopted for the year of 1922:

Editor, salary and clerical help	$300.00
Salary of secretary	100.00
Expenses and clerical help of secretary	100.00
	$500.00

[1] Credit is due President C. H. Eckles and Secretary N. W. Hepburn for assembling the data for this report.—*Editor.*

Motion carried.

Professor Lockwood moved that we commend the Department of Agriculture for their very fine exhibit at the dairy show this year. The motion carried.

Moved by Professor Gamble that we send an expression of our appreciation to those who have furnished cups and medals in connection with our student judging contest held at the show. Motion carried.

Presentation of Reports

The attention of the session was next turned toward committees reporting to the general session.

REPORT OF THE MEMBERSHIP COMMITTEE

J. A. Gamble, Maryland, Chairman

(An abstract of this report is published on page 156.)

Following this report it was moved by Professor Hunziker that the membership be classified into sections and that each member be furnished with a list of the membership showing complete classification. Motion carried.

REPORT OF COMMITTEE ON CONSTITUTION AND BY-LAWS

Prof. M. Mortensen, Iowa, Chairman

The committee recommended that article 3 of the Constitution, defining membership, be amended to read as follows:

Article 3. Membership shall be of one kind only; namely, Active.

Article 4. The following are eligible for election: Any person who is formally announced by an Agricultural College, or Experiment Station, or by the Dairy Division of the United States or Canadian Departments of Agriculture as an instructor, extension worker, investigator or administrative officer connected with the dairy industry, or anyone filling a position of responsibility connected with the dairy industry, and who has had a college or university training in technical science, or anyone filling a responsible position in the industry of a professional character requiring a technical knowledge of dairying of a high order.

The following additions to the By-Laws were recommended:

Article 6. A committee of five on elections shall be appointed by the president. Said committee shall make a report at the annual meeting in which the names of

two members shall be suggested for each office to be filled by mail ballot under the provision of the constitution. In addition thereto, a group of five or more members may suggest other names for consideration, but such requests shall be in the hands of the secretary of the association before November 1st.

Article 7. In conducting mail ballots only those ballots shall be counted which are received by the secretary within four weeks from the date upon which the ballots were mailed by the secretary.

Article 8. Section Meetings. The time and place of meeting for the Sections of the Association shall be fixed by the Executive Committee. All other arrangements regarding the section meetings shall be made by the officers of the section.

These recommendations were adopted. The constitution and by-laws as revised by this action are printed in full on pages 194–197.

REPORT OF THE COMMITTEE ON BACTERIOLOGICAL METHODS FOR MARKET MILK

Dr. R. S. Breed, New York, Chairman

An informal report was presented by the chairman calling attention to the publication of the third edition of the Standard Methods for the Bacteriological Examination of Milk in January, 1921. Copies of this report are obtainable from the Secretary of the American Public Health Association, 370 Seventh Avenue, New York City. The report as published is a joint report of committees representing the American Public Health Association, the American Dairy Science Association, the International Dairy and Milk Inspectors Association, and members of committees from the Society of American Bacteriologists and the American Association of Medical Milk Commissions.

It was also stated that in New York State, where the matter of paying for milk as delivered by dairyman on the basis of the bacterial count, has made rapid strides, a bill is to be introduced at the coming session of the legislature establishing a control over the making of bacterial counts where these are used as a basis for payment. The essential part of this control is that analysts must submit to examination in order to secure a license, that graduated glassware is to be examined for accuracy by the State and that the methods used in taking samples and in carrying out the analyses are subject to review by state authorities.

REPORT OF COMMITTEE ON DAIRY SHORT COURSE INSTRUCTION

Prof. J. R. Keithley, Minnesota, Chairman

(This report is published in detail on page 160.)

The meeting adjourned for lunch, the President announcing that the membership would convene by sections for the afternoon session.

PROCEEDINGS OF SECTION I, DAIRY PRODUCTION

Meeting called to order by Chairman Regan. Secretary absent.

P. S. Williams was appointed temporary secretary.

The possibilities of a new dairy cattle score card were discussed. The opinion of members present seemed to be in favor of a revised score card. It was moved and seconded that a committee be appointed to study the score card and make suggestions at the next meeting. Reports of standing committees were next called for.

Report of the committee on methods of conducting student judging contests. W. W. Swett, Chairman

Mr. W. W. Swett read report. Moved and seconded that the report of the committee be accepted. It was the opinion of some that the name of the official judge of each breed for the contest be published in the catalogue and that the same judge be used for the contest as for the show.

Mr. Borland brought up the matter of an individual judge for the contest and stated that the official judge in a certain breed was not upheld in his judgment by 40 out of 45 contestants. He was in favor of a three judge system. The matter of appearance of cows at time of judging being different when officially judged and when judged by the contestants was discussed and it was thought advisable to have the judge see the cows at the same time as contestants.

Professor Rayburn suggested that the judge select his own cattle for the contest. It seemed to be the opinion of several men that the judge should select the cattle.

H. P. Davis was in favor of having 5 or 6 animals in each class, at least in female classes and reasons only be used in classes where prizes are offered.

Professor O. E. Reed suggested that a committee be selected from the group of coaches, 2 or 3 men to judge each breed. This committee to be selected by a committee of the American Dairy Science Association for the contest.

The report of the committee was accepted by unanimous vote of the section.

Report of committee on organization. W. W. Swett, Missouri, Chairman

A constitution and (by-laws) were drawn up by the committee and read at the meeting. A suggestion was made by Ragsdale to have meetings of sections at separate times. The question of limiting of members was discussed. Ragsdale proposed that at certain times all members should not be allowed to vote.

H. P. Davis moved that article 3 concerning membership as read by committee be accepted. Motion seconded and carried.

The reading of article concerning officers shall read chairman rather than president.

Mr. Eckles suggested that few standing committees be appointed. The report of the organization committee was accepted and Mr. Dice was appointed as a committee on dairy score card to report next year.

Officers elected were: W. M. Regan, New Jersey, chairman; A. C. Ragsdale, Missouri, vice-chairman; E. L. Anthony, West Virginia, secretary.

Adjournment.

(Signed) PAUL S. WILLIAMS,
Temporary Secretary.

PROCEEDINGS OF SECTION II, DAIRY MANUFACTURES

Session called to order at 2:00 p.m., in Dairy Hall, University of Minnesota. In the absence of Chairman Potts, Professor A. W. Rudnick presided. The first order of business was the call for the report on "Organization."

Report of committee on organization. O. F. Hunziker, Chicago, Chairman

Your committee on organization of the section of dairy manufactures beg to submit the following report:

1. Membership. Your committee recommends that any member of this Association be eligible to the membership of the section of dairy manufactures, and that each Association member desiring to become a member of this section be requested to so register by filling out a card of membership furnished by the Secretary of this Association.

2. Standing committees. It is the sense of your committee that there is danger of confining the activities of this section too exclusively to committee work and committee reports. This, we fear, may disadvantageously affect the attractiveness of our sessions and the service it is our purpose to render the dairy industry.

We feel that the purpose and effectiveness of our work demand that the number of subjects assigned to committees be restricted to the minimum and that committees only be appointed on subjects for the adequate consideration of which committee work is indispensable.

We, therefore, beg to recommend that the committees for the Section of Dairy Manufactures for the ensuing year be confined to the following standing committees:

Committee on organization
Committee on legal standards and score cards for dairy products
Committee on official methods for testing dairy products
Committee on dairy products judging contests

3. Program. Your committee beg to further recommend that the sectional leader shall appoint individuals to present a résumé covering the current situation and other matters of vital interest regarding the diverse phases of their respective branch of the industry; these individuals to be appointed immediately after the regular annual meeting. These résumés or reports should

form a most valuable part in the program of the annual meeting of the succeeding year.

R. S. BREED,
J. H. FRANDSEN,
J. A. GAMBLE,
O. F. HUNZIKER,
Committee.

Report of committee on legal standards and score cards for dairy products. J. H. Frandsen, Chairman

(This report is published on page 164.)

Moved that the legal standards committee be instructed to investigate the weight and total solids standard for ice cream. Motion carried.

Report of committee on dairy products judging contest. Prof. A. W. Rudnick, Chairman

(This report is published on page 168.)

Following this report it was moved by Professor Mortensen that a special committee with Professor Gamble as chairman, be appointed to study the rules and regulations pertaining to the judging of milk. Motion carried.

Professor Bouska made a motion favoring the appointment of a committee for the purpose of standardizing the terms used in criticizing the characteristics of butter in reference to judging the same. Motion carried.

Professor Mortensen moved that a list of ten or twelve judges of national reputation for each of the three dairy products be given to General Manager Skinner and that judges for dairy products in the student contests be selected from this list. Motion carried.

Moved that not more than one judge can hold over from one year to the other. Carried.

Report of committee on official methods for testing milk and cream for butter fat. O. F. Hunziker, Chicago, Chairman

(This report is published on page 175.)

The following were elected officers of the Manufactures Section for the ensuing year: L. A. Rogers, Washington, D. C., president; C. L. Roadhouse, California, vice-president; H. A. Ruehe, Illinois, secretary.

Adjournment.

A. W. RUDNICK,
Secretary.

PROCEEDINGS OF SECTION IV, OFFICIAL TESTING

The following men were present at the meeting: E. L. Anthony, West Virginia; R. B. Becker, Kansas; P. M. Brandt, Oregon; H. P. Davis, Nebraska; J. R. Dice, North Dakota; C. H. Eckles, Minnesota; L. H. Fairchild, Indiana; C. R. Gearhart, Kansas; Roy T. Harris, Wisconsin; L. W. Morley, Pennsylvania; W. E. Peterson, Minnesota; A. C. Ragsdale, Missouri; Wm. J. Regan, New Jersey; Chas. W. Turner, Missouri; P. S. Williams, Pennsylvania; H. H. Wing, New York; E. G. Woodward, Washington; C. E. Wylie, Tennessee.

Voting membership in the section is limited to heads of Dairy Departments, and men actively in charge of Official Testing work. Others especially interested are invited to attend meetings, but have not the privilege of voting. Voting is done by states, each state having but one vote.

Meeting called to order by chairman H. P. Davis.

In the absence of Secretary M. H. Fohrman, the chairman appointed R. B. Becker (Kansas) as temporary secretary.

Moved by A. C. Ragsdale and seconded that the reading of the report of the last meeting be dispensed with. Motion carried.

Report of the committee on relation to breed associations. E. G. Woodward, Washington, Chairman

The report of this committee has been divided into three subcommittee reports as follows:

1. Administration, Roy T. Harris and W. W. Yapp.
2. Uniform rules, H. N. Colman and J. B. Fitch.
3. Financing test work, Wm. J. Regan and G. C. White.

(These reports are found on page 183.)

1. Report of the sub-committee on administration of official testing work within the United States. Roy T. Harris, Wisconsin, Chairman

(See page 183)

It was decided to read reports section by section, making amendments, and voting on the completed reports.

Discussion. H. H. Wing approves the adoption of uniform report forms, and elimination of all material except scattered or previous milkings.

H. P. Davis and C. W. Turner suggested that a full exhibit of forms used by the different institutions should be collected for exhibit at the next annual meeting.

Moved by E. L. Anthony that the secretary gather the forms used by the institutions, and prepare an exhibit for the committee on relation to breed associations, and that they prepare tentative general forms to submit to the different institutions. Motion passed.

Moved and seconded that report on "administration" be adopted as approved. Motion passed.

2. Report of the sub-committee on uniform rules for the conduct of official records of dairy cows. H. N. Colman, Oregon, Chairman

(See page 184)

Report of sub-committee on uniform rules read by P. M. Brandt, substituting for H. N. Colman. Rules read by section. Voting was conducted by states.

Speech of welcome made by the chairman, H. P. Davis, to the representatives of the breed associations who came at this time. These were:

Secretary and Mrs. Malcolm H. Gardner, Holstein-Friesian Association of America.

Secretary Wm. H. Caldwell, American Guernsey Cattle Club.

Secretary C. L. Burlingham, Ayrshire Breeders Association.

Secretary R. M. Gow, American Jersey Cattle Club.

Chief of registry of merit O. H. Baker, American Jersey Cattle Club.

Secretary Caldwell said in substance: The American Guernsey Cattle Club wishes to retain absolute control of the conditions under which a cow can enter the Advanced Registry. The Club asks that the owner's reports be absolutely accurate and honest in reporting the milk and feed record. The Club asks that the state institutions, as a third disinterested party, report the official tests. The Club desires the close coöperation of the state institutions in maintaining the authenticity of the advanced registry work.

Secretary R. M. Gow spoke about as follows: The American Jersey Cattle Club appreciates the help the colleges have been in management of tests. Any rules which the colleges feel would make the records still more accurate, will be supported by the Club. The American Jersey Cattle Club recognizes any rules made by the state institutions supervising tests which are practical and proper to make in safeguarding the register of merit work.

O. H. Baker, Chief of Registry of Merit Department, spoke about as follows: The American Jersey Cattle Club has certain fundamental rules which are required, and in addition will support any additional rules of any state institution to safeguard the records. The right is reserved to chart apparently abnormal production records by the "graph system."

Secretary Gardner discussed the methods of using figures reported to the third decimal place in computing records. He asked that the states select supervisors who will not be influenced by environment or by flattery. The need is for supervisors who will give an impartial report of the production of cows on test. The graph system, as used by the Holstein-Friesian Association of America in charting apparently abnormal production, was explained.

Secretary C. L. Burlingham found the same problems in handling breed work with the Ayrshire cattle that have been found with the other breeds. He praised the organization of the American Dairy Science Association in trying to bring about uniformity and accuracy in handling official testing work.

The addresses of the breed representatives were followed by a full discussion of problems affecting both the state institutions and the breed associations, and a much better understanding of them obtained.

Mrs. M. H. Gardner spoke especially of the conditions which test supervisors are called upon to meet, and praised the integrity of these men in maintaining a high standard of excellence in their testing work.

3. Report of sub-committee on methods of financing official testing. Wm. J. Regan, New Jersey, Chairman

(See page 189)

Full discussion of financing problems was taken up, including consideration of methods of providing funds for financing official testing work. Consideration was given to (1) breed associations handling finance of tests; (2) breed associations providing money to establish rotating funds at the several institutions; (3) that breed associations act with breeders in each state, asking the legislature to provide a rotating fund; (4) that each institution, by fees charged to each breeder, gradually build up its own revolving fund.

Moved by A. C. Ragsdale that the recommendations or suggestions of the Official Test section of the American Dairy Science Association be presented in writing to the breed secretaries. Motion carried.

Report by W. E. Peterson (Minnesota), Roy T. Harris (Wisconsin) and R. B. Becker (Kansas) concerning the value of a preliminary milking in getting a representative production during the two-day test period, upon which semi-official records are largely based. It was stated that a full report of experimental work conducted by the Kansas Experiment Station will be reported in the JOURNAL OF DAIRY SCIENCE.

C. H. Eckles reported on the attitude of breeders and herdsmen toward the work of the supervisors.

Moved by W. E. Peterson that a rising vote of thanks be extended to the representatives of the breed associations for attending the meeting, and taking part in the discussion of problems affecting official testing work. Motion carried.

Report of sub-committee on "uniform rules" was resumed.

Moved by P. M. Brandt and seconded, that article VI be taken from the table, and considered for adoption. Motion carried.

Article VI adopted.

A. C. Ragsdale recommended that section III be offered as suggestions to bring before the breed associations.

Moved by Wm. J. Regan, seconded by E. G. Woodward, that report of sub-committee on uniform rules be adopted. Motion carried.

Moved by E. G. Woodward and seconded, that report of sub-committee in financing test work be adopted.

Discussion: Report does not cover question of revolving fund to finance official testing work.

Motion carried.

Moved by A. C. Ragsdale and seconded that chairman of committee on relation to breed associations submit copies of these rules to the different institutions supervising tests, and that the recommendations be presented to the officials of the dairy cattle breed associations. Motion carried.

Moved by L. H. Fairchild that chairman of committee on relation to breed associations arrange for a meeting of officers of the breed associations with this committee at an early date. Motion seconded and carried.

Report of committee on by-laws for the official testing section of the American Dairy Science Association, presented by E. G. Woodward.

Moved and seconded that report of committee on by-laws be accepted as finally approve Motion carried.

Moved by Wm. J. Regan that L. H. Fairchild be appointed a committee of one to prepare and report at the next annual meeting on the "composite test." Motion carried.

Moved by Wm. J. Regan that a committee be appointed by the chairman to outline investigations which should be made regarding factors affecting official tests. Motion seconded and carried.

Annual election of officers.

The following officers were elected by unanimous ballot:

Chairman	H. P. Davis, Nebraska
Vice chairman	L. H. Fairchild, Indiana
Secretary	Roy T. Harris, Wisconsin

Adjournment followed.

R. B. BECKER,
Temporary Secretary.

ABSTRACT OF THE REPORT OF THE MEMBERSHIP COMMITTEE

J. A. Gamble, Maryland, Chairman

The first effort of your committee was to assemble, from available lists, the eligibles in the United States and Canadian Departments of Agriculture, the different state colleges and experiment stations, and other bodies so that we might know the total number from which we had to draw in carrying on a campaign, looking toward getting the leaders in dairy husbandry work in the field of teaching, extension and research into the American Dairy Science Association. At that time, articles 3 and 4 regarding membership read as follows:

MEMBERSHIP

Article 3. Membership shall be of two kinds, active and associate.

Article 4. The following are eligible for election as active members:

(1) Any person who is formally announced by an Agricultural College or Experiment Station or by the Dairy Division of the United States or Canadian Departments of Agriculture as an instructor, extension worker, investigator, or administrative officer connected with the dairy industry.

(2) Anyone filling a position of responsibility connected with the dairy industry of a professional character requiring technical scientific training.

Article 5. An active member ceasing active duties in connection with the dairy industry is transferred to associate membership. Any person interested in the dairy industry but not eligible under the qualifications prescribed for active membership may be nominated for associate membership. Associate members shall be entitled to all the privileges of the society except that of voting.

There were over 1200 such workers in the United States eligible under the above outline. This list disclosed that a large number of the leaders in the several fields were not as yet members of this body.

The following material, showing the scope of the Association, together with an application for membership was printed after the approval of the President and sent to all eligibles not appearing on the list of members furnished the committee by the Secretary of the Association.

THE AMERICAN DAIRY SCIENCE ASSOCIATION

The membership committee cordially invites you to be one of the new members who are joining our ranks this year.

The American Dairy Science Association is the professional organization of the dairy workers of this continent bearing to our profession somewhat the same relationship as the American Medical Association bears to the physician and the American Chemical Society to the chemist.

Ours is a working organization as well as a forum for discussion and an agent for the dissemination of scientific information. Its committees are constantly active in the improvement and standardization of technic, the improvement in dairy instruction, the stimulation of scientific research in all phases of the subject and improvement in methods of conduction of extension work.

The American Dairy Science Association is the most powerful single force in this continent for the advancement of the science of dairy husbandry. The Association holds an annual meeting usually in connection with the National Dairy Show, which furnishes an opportunity for all dairy husbandry workers of the country, whether their special interests lie in the field of teaching, research or extension, or handling and manufacture, to meet each other and to see the latest in dairy machinery and the best in dairy cattle.

Every two months we publish the *Journal of Dairy Science*, unique in its scope among the scientific publications of the English-speaking world. The *Journal of Dairy Science* is a medium for the publication of original communications, brief or extended, dealing with dairy husbandry problems. Its broad scope includes market milk handling, cheese making, ice cream manufacture, condensed milk, milk powder, butter making, nutrition, dairy cattle breeding problems, dairy chemistry, dairy bacteriology, dairy management, and dairy engineering.

The Association has at present time over 200 members. Before the end of the present year, it is hoped that our membership will be over five hundred members. The dues of the Association are $5.00 a year, this including a year's subscription to the *Journal*. An application is attached to this letter which may be filled out and mailed in the enclosed envelope to J. A. Gamble, Chairman of Membership Committee, University of Maryland, College Park, Maryland.

MEMBERSHIP COMMITTEE OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

This was followed up by a circular, containing friendly comments on our *Journal of Dairy Science* prepared by Williams & Wilkins Company, Baltimore, Maryland, and setting forth the scope and the value of our magazine to those receiving the same. These comments were by the heads of the dairy departments in the different state colleges, by the officials of the breed associations, and by the different dairy companies and manufacturing supply houses.

The third step was the sending of a circular in the "Get a Member" campaign, to all men on the association rolls.

This circular made an urgent appeal to each member to get in touch with some fellow-worker eligible for membership and after acquainting him with the nature and scope of the work of the American Dairy Science Association, to extend to him a cordial invitation to membership.

This circular also stated the rules for eligibility as set forth in the constitution and urged members to take prompt action in order that all applications might be in before the annual meeting.

An "Application for Membership" blank was enclosed. The circular was followed up in ten days by a reminder urging members to send in the name of a new member so that a hundred per cent efficiency campaign might be reported at the St. Paul meeting.

At the St. Paul meeting, held in connection with the National Dairy Show, October 8th to 12th, 1921 the eligibility rules were changed to read as follows: thus doing away with the associate membership.

MEMBERSHIP

"*Article 3.* Membership shall be of one kind only; namely, Active.

"*Article 4.* The following are eligible for election:

"Any person who is formally announced by an agricultural college, or experiment station, or by the Dairy Division of the United States or Canadian Departments of Agriculture as an instructor, extension worker, investigator, or administrative officer connected with the dairy industry, or anyone filling a position of responsibility connected with the dairy industry and who has had a college or university training in technical science, or anyone filling a responsible position in the industry of a professional character requiring a technical knowledge of dairying of a high order."

On this basis, a list of the eligibles in the different sections was prepared and sent to the sectional members of the committee for the purpose of getting into the Association, the qualified men in the industry. The committee found that a great many men hesitated to come into the organization for the reason that they were unable to attend the annual meeting held in connection with the National Dairy Show. At this meeting, in St. Paul, permission was granted for the formation of sectional groups of the American Dairy Science Association. This will have a tendency to overcome this objection on the part of these men. Inasmuch as invitations have been extended to eligibles for active and associate membership under the old rules, the sectional leaders were instructed to accept applications under the old interpretation, but to make the new interpretation of eligibles their basis for additional work along this line.

The executive committee have ruled that the names of all eligibles shall be submitted to and have the approval of each member of the executive committee of the Association, before membership in the Association is offered to them. Under this plan, membership forms are to be prepared by the Association. These are to be furnished to the different sectional members of the committee who will send them to the heads of Dairy Husbandry Departments in the different Agricultural Colleges so that these heads may nominate for membership, any on their staffs or associated with them whom they deem eligible for nomination for active membership in the Association. These forms will be returned to the president of the Association through the chairman of the committee at College Park, Maryland. All these whom the executive committee deem desirable will receive a direct invitation to affiliate with us.

Results

As a result of the activities of the membership committee and many members of the Association, the committee is able to report that the applications of 110 were handled directly by the membership committee. This number does not include the applications sent direct to the president or secretary of the organization, nor does it include the back dues forwarded through the committee. The 110 men meant checks totaling $550. It means also that the Association is now in a better position to serve its members at no increased cost.

The committee desires especially to thank Dr. Eckles, president of the Association, Professor Mortensen, the retiring president, and all other workers who have assisted in making the above results possible.

We wish to especially thank Mr. C. C. Thomas and the Williams & Wilkins Company who have furnished the printing for this campaign gratis. Also, the Dairy Husbandry Department of the University of Maryland, which furnished the material, did a large share of the work, and with the assistance of the Association, subsidized the membership drive.

H. F. JUDKINS,
W. H. E. R. REID,
THOMAS WRIGHT,
V. D. CHAPPELL,
J. A. GAMBLE,
Committee.

REPORT OF COMMITTEE ON DAIRY SHORT COURSE INSTRUCTION

J. R. Keithley, Minnesota, Chairman

Many of our colleges of agriculture offer instruction relative to the dairy industry. This instruction is, in most cases, divided into two classes, one of which is principally concerned with problems of milk production, the other with problems of handling, manufacturing and marketing of dairy products. This instruction is generally presented to three rather distinct classes or groups of students, whose needs requirements and fundamental training differ distinctly as follows: (a) *The collegiate student* obtains this instruction only as a part of his university education. (b) *The student in the secondary schools of agriculture* receives this instruction also only as a part of his more generalized practical agricultural education. (c) *The true short course student* in dairying devotes all of his time to and receives instruction only in dairying or some one specialized phase of it.

It was the understanding of the committee that only the *true short course instruction* was to be considered at this time. A study of the survey obtained by a questionnaire shows that these courses vary in their nature, and rightly so. This variation is due to local or sectional demands or needs. In some sections this demand is more urgent from the production field, in other sections it is more urgent from the manufacturing side. A summary of the questionnaire survey shows that the answers to the questions were as follows:

1. Does your college offer any short courses in Dairy Husbandry? If so, what courses are offered?

Twenty-two answered in the negative and twenty-six in the affirmative.

Those answering in the negative were: Alabama, Arizona, Arkansas, Colorado, Connecticut, Delaware, Florida, Louisiana, Maryland, Mississippi, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Rhode Island, South Carolina, Texas, Virginia, West Virginia, Wyoming.

Those answering in the affirimative were: California, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New York, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Tennessee, Utah, Vermont, Washington, Wisconsin.

2. How many students were enrolled in each dairy short course offered by your college during the past year?

The number varied from 3 to 100 in each course and from 3 to 190 in each college or university. The total number of dairy short course students was 1149. The length of courses vary from one week to six months.

3. What are the aims of such courses? Are those aims being attained?

These aims vary somewhat and are as follows:

a. Through a knowledge of theory and practice to produce more capable helpers for the ice cream, butter, cheese and milk plant operators and owners.

b. To train home demonstration agents to instruct farm women in best methods of handling dairy products and in the care and management of dairy cows.

c. To present to farmers some of the most important problems of the present day and discuss problems which they themselves bring up.

d. To acquaint young men with livestock so they may prove more useful men on farms and will work toward positions as herdmen, managers, and eventually owners.

e. To teach the elements of dairying relative to breed, selection, breeding, feeding, care and management, as well as manufacturing of dairy products.

f. To offer instruction to men and women who wish to take up general farming.

g. To prepare specialists in dairy manufactures so as to be capable of taking charge of small creameries, milk plants, cheese factories, or of ice cream factories.

h. To prepare men to act as supervisors for A. R. O. and cow testing association work.

i. To instruct the producers concerning the essentials in producing and delivering a sanitary milk or cream to the dealers.

4. Will you please offer suggestions as to ways in which you consider it possible to make improvements in this type of dairy courses?

Suggested improvements are as follows:

a. Divide Short Courses on basis of (1) Care and feeding of cows, (2) handling and manufacture of dairy products.

b. Operate a commercial plant using up-to-date equipment. Admit only experienced man (one year) and have special instructors.

c. Present only material having a direct bearing and make this concise and to the point. Have first-class practical men assist in instruction giving all laboratory work possible. Limit the theoretical work.

d. Lengthen the courses. In production work include judging. In manufacturing courses cover fewer subjects.

e. Have scholastic entrance requirements as well as experience requirement. Lecture method is best for experienced men, but textbook and recitation method is best in the longer courses for the less experienced men.

f. Instead of general course in dairy manufactures, specialized courses in each of the following should be given: butter, cheese, ice cream, and market milk.

5. What principal difficulties have been encountered by your institution in giving dairy short courses instruction?

The principal difficulties mentioned were as follows:

a. In many states demand is not sufficient to warrant dairy short courses.

b. Lack of facilities, in men, money, and equipment.

c. Creates too heavy teaching load for regular college staff because short course work is added to the regular college and school duties.

d. Presenting material to experienced and inexperienced men in same class in such a way as to satisfy both.

e. Selecting suitable seasons of year for representative work.

f. Lack of good teachers.

6. Will you please send descriptive bulletins, circulars, catalogs, or other statements relative to short courses?

Twenty institutions sent descriptive bulletin or materials.

7. Do you follow the lecture method of instruction for short course students?

The method of instruction, in most cases, was lecture and laboratory supplemented by assigned readings, recitation and discussion.

8. To what extent do you use a textbook? What textbooks do you use for short course students?

Answers indicated that textbooks used varied with the nature of the short course offered.

9. To what extent is the instruction given by the regular college staff and special instructors?

Answers indicated that short course instruction is given by the regular college staff. The following states have additional special instructors: California, Illinois, Iowa, Minnesota, New York, Ohio, Oregon, Pennsylvania, Vermont, Washington and Wisconsin.

10. How are the instructors paid? In answer:

a. The regular staff members are not paid additional for short course work.

b. The special instructors receive expenses, and in some cases, $7.00 to $15.00 daily.

1. To what extent are products handled or manufactured in these courses?

Answers indicated that products are made only on a small scale, to illustrate principles, by colleges not having commercial plant. Those having a commercial plant make somewhat large quantities but for the same purposes. Some churn three or four times daily, and make up cheese from 1200 to 1500 pounds milk daily.

Ice cream is made in from 50- to 200-gallon lots per laboratory exercise.

12. Will you please supply us with lecture and laboratory outlines followed by students in these courses?

In response, lecture and laboratory outlines were submitted by Massachusetts, New York and Pennsylvania. Others have no definite outlines available but vary their programs to meet desires of students enrolled.

The Committee would recommend:

1. Adoption of more uniform, standardized short course instruction among the colleges and universities where desirable and possible.

2. Such uniformity and standardization would be aided through definite lecture and laboratory outlines being made available.

3. A wider use of available textbooks to supplement lectures and laboratory work would be desirable.

4. Sufficient laboratory work be required to fix clearly in the student's mind the principles involved in the work under consideration.

H. W. GREGORY, Indiana,
P. M. BRANDT, Oregon,
J. R. KEITHLEY, Minnesota,
Committee.

REPORT OF COMMITTEE ON LEGAL STANDARDS AND SCORE CARDS FOR DAIRY PRODUCTS

J. H. Frandsen, Nebraska, Chairman

Your Committee on Score Cards for Dairy Products has had considerable correspondence and sub-committees have held a number of meetings in which much attention has been given to new score cards. This year most of the time has been given to consideration of score cards for sweetened condensed milk, evaporated milk and ice cream.

Regarding sweetened condensed milk, your committee desires to recommend a tentative score card consisting of the following items:

SCORE CARD FOR SWEETENED CONDENSED MILK

Properties	*Perfect score per cent*
Flavor and odor	30
Body and texture	25
Color	5
Fat content	10
Milk solids	10
Bacteria	10
Sugar	10
Adulterants and preservatives (must be absent)	—
Total score	100

Suggestions for use of score card

Flavor and odor. Perfect; must be fresh, sweet and free from all flavors. Deduct one to ten points each if metallic, rancid, stale, cheesy. Deduct one to thirty points if sour, yeasty or otherwise fermented.

Body and texture

Perfect: Must be viscous, smooth and free from lumps of curd, sugar sediment and foreign impurities. Deduct one to five points if rough and sandy, from one to five points if sugar sediment in bottom, from one to five points if fat separation, one to five points if white and yellow buttons, 15 to 25 points if lumps of curd.

Color

Perfect: Rich cream to yellow. Deduct one to five points if brown.

Fat content

Perfect: Must contain not less than 10 per cent milk fat. Deduct one point for each half per cent less than 10 per cent. If below 8 per cent deduct ten points. Deduct ten points if below 8 per cent present Federal Standard.

Total milk solids

Perfect: Must contain not less than 32 per cent. Deduct one point for each per cent or fraction thereof below 32 per cent. If below 28 per cent deduct ten points.

Sugar

Perfect: The concentration shall be from 60 to 62 per cent. Deduct two points for each per cent concentration below 60 or above 62 per cent. The concentration shall be determined by *dividing* per cent of sugar by the sum of per cent of sugar and water.

Bacteria

Make reduction for excessive number of bacteria. Importance of bacterial counts has not as yet been sufficiently considered by the committee to warrant definite recommendations.

SCORE CARD FOR EVAPORATED MILK

Regarding evaporated milk, the following score card is tentatively suggested.

Properties	*Perfect score per cent*
Flavor and odor	40
Body and texture	35
Color	5
Fat content	10
Total solids	10
Adulterants and preservatives must be absent	—
Total score	100

Flavor and odor. Perfect: Must be fresh, sweet and free from off flavors. Deduct 1 to 10 points if metallic, rancid and stale. Deduct 40 points if sour, bitter, putrid, gassy or otherwise fermented.

Body and texture. Perfect: Must be creamy, of uniform emulsion, smooth. Deduct 1 to 10 points each for curdy milk, separated or churned milk.

Color. Perfect: Must be creamy. Deduct 1 to 3 points if brown.

Fat content. Perfect: Must contain not less than 9 per cent milk fat. Deduct one point for each one-half per cent less than 9 per cent. Deduct 10 points if less than 7.8 per cent the present Federal Standard.

Total solids. Perfect: Must contain not less than 28 per cent solids. Deduct 1 point for each 1 per cent or fraction thereof, less than 28 per cent. Deduct 10 points if below 25.5 per cent, present federal standard.

Adulterants and preservatives. Perfect: Must be free from all adulterants or preservatives. If it contains animal or vegetable fats, or other ingredients foreign to the composition of normal milk, or any preservatives deduct 100 per cent.

MILK POWDER

The committee has under consideration a score card for milk powder but do not feel justified in making a definite recommendation at this time.

ICE CREAM

Regarding ice cream score card, your committee recommends that the following score card be tentatively recommended for the coming year and that all interested users furnish the committee with their suggestions regarding same so that during the year they may have more available data on which to base further recommendations.

SCORE CARD FOR ICE CREAM

Flavor	40
Body and texture	25
Fat and solids	10
Bacteria	20
Package	5
Total	100

MILK SCORE CARD

Your committee, in the absence of data supporting a change, recommend the adoption of the milk score card tentatively used by the Ameri-

can Dairy Science Association this year and which carries the following items:

Bacteria	35
Flavor and odor	25
Fats	10
Solids-not-fat	10
Sediment	10
Acidity	5
Bottle and cap	5
Total	100

The above report has the approval of all members of the score card committee present at meeting.

O. F. HUNZIKER,
L. A. ROGERS,
J. A. GAMBLE,
W. P. B. LOCKWOOD,
J. H. FRANDSEN,
Committee.

As chairman of the committee, I desire at this time to acknowledge my appreciation for the fine work done by Professors O. F. Hunziker and L. A. Rogers, who constituted the sub-committee doing most of the work on condensed milk score card, and to Professors J. A. Gamble and W. P. B. Lockwood for their work on milk score card, and of all the members of the Committee who assisted in the preparation of this report.

J. H. FRANDSEN,
Chairman.

REPORT OF COMMITTEE ON STUDENTS' NATIONAL CONTEST IN JUDGING DAIRY PRODUCTS

A. W. Rudnick, Iowa, Chairman

The Students' National Contest in Judging Dairy Products shall be a contest among agricultural students—individuals and teams—in judging the quality and market grade of butter, cheese and milk.

Ten samples of each product shall be scored, placed and criticized. This contest shall be held annually at the National Dairy Show and shall be under the direct supervision of the Dairy Division, United States Department of Agriculture, a member of which division shall be the superintendent of the contest.

Any student of a land-grant agricultural college, or of a secondary school under direct supervision of a land-grant state agricultural college, who is regularly matriculated in a course of at least two years in agriculture or dairying and has taken not less than twelve weeks undergraduate work during the calendar year in which the show is held, who has never taken part in any contest for judging dairy products of a national or international character, who has never acted as an official judge of dairy products, and who has not taught the manufacture of, or the judging of dairy products, may enter as a member of a team. Three men from any one college or school shall constitute a team.

RULES GOVERNING CONTEST [1]

1. All entries must be received by Mr. W. E. Skinner, General Manager of the National Dairy Show, not later than one week previous to the date of contest.

Regular entry forms will be mailed in due time to the professor of dairying, or dairy manufacturing, in each state agricultural college.

2. An entry fee of two dollars ($2.00) is charged each contestant, and this must be forwarded with the entry form. The money received from this source is used in helping defray expenses of the contest.

3. Each institution eligible to participate in this contest may enter a team, consisting of three eligible students of that institution.

4. Each contestant shall report to the superintendent of the contest at such time and place as may be announced. He will then be assigned a number and given such instructions as the superintendent may deem necessary.

5. The contestants shall be divided into three groups, each consisting of one member of each team.

6. No contestant shall wear any uniform, college colors, college hat or college pin which may in any way reveal his identity or the identity of the college which he represents.

7. No contestant shall be allowed to take any note-book or writing paper into the contest, except such cards as are provided by the superintendent of the contest.

8. While the contest is in progress, there shall be no communication between the contestants or between contestants and anyone else, except as directed by the superintendent or his representative, and then only in the presence of the superintendent or his representative.

9. Reporters, officials and others, except the contestants, the superintendent and his assistants, shall be excluded from the place of scoring while the contest is in progress.

10. Any contestant violating any rule will be debarred from the contest. If a member of any team is debarred because of violation of rules, that team will be debarred from the team contest, although the remaining members may compete for the individual prizes.

11. Each contestant, on entering the place of contest will be given score cards on which to record his scores and criticisms. At the expiration of the allotted time all score cards shall be returned to the superintendent. The contestant shall place on each card the number assigned to him.

12. Dairy products will be scored on the following basis:

Butter		*Cheese*		*Market milk*	
Flavor	45	Flavor	45	Flavor and odor	25
Body	25	Texture	30	Sediment	10
Color	15	Color	15	Bottle and cap	5
Salt	10	Make-up	10		
Package	5				
Total	100	Total	100	Total	40

The butter, as far as practicable, shall be scored and criticised in accordance with the system outlined in Service and Regulatory Announcement No. 51 of the Bureau of Markets, United States Department of Agriculture.

13. Each contestant shall score and criticise ten tubs of butter, ten cheese, and ten samples of milk, the time allowance being one hour for each product.

14. No member of the teaching, extension or experimental staff of a college entering a team, may act as an official or be in any way connected with the Dairy Products exhibit of the National Dairy Show.

15. Each contestant shall place the samples in order according to their total scores. Placing the number of the highest sample first, the second highest second, etc.

16. The superintendent shall set out not more than five representative samples of each product on the afternoon preceding the contest. The time to be specified by the superintendent. Not more than one such exhibit shall be prepared and all contestants shall be notified of the time at least ten days in advance.

SUPERINTENDENT OF CONTEST

It shall be the duty of the superintendent of the contest to see that all rules and regulations governing the contest are duly carried out, and shall see that the contest is conducted with fairness and justice to all concerned.

He shall have a sufficient number of clerks and assistants to help him in conducting the contest.

He shall direct the contestants as to the products to judge, time to commence work and time to stop.

After instructing the contestants in a body regarding the contest, the form in which to prepare the scores and criticisms, etc., he shall say nothing to any contestant as to method for the contestant to follow, in scoring.

He shall have charge of all records and shall have all ratings tabulated and totaled, and shall deliver the results of the contest to the general manager of the National Dairy Show.

He shall decide all questions which may arise in connection with the interpretation of the rules governing the contest, and may make additional rulings to facilitate the working of the general rules.

CLERKS AND ASSISTANTS

One assistant shall have charge of each group of contestants and shall see that each contestant in his group remains in his presence the entire time the contest is in progress; except in cases of emergency, and then as directed by the superintendent.

Clerks shall also be provided for the judging committee.

PRODUCTS AND MARKING

The products shall be provided by the National Dairy Association.

A member of the United States Department of Agriculture shall select ten tubs of butter, ten cheeses, and ten samples of market milk which in his judgement will make a representative scoring contest for each product.

The packages shall be numbered consecutively and the numbers be marked plainly on the packages.

JUDGES

The official scores and criticisms shall be placed on these products by a committee consisting of a commercial judge and judge from the United States Department of Agriculture, for butter, and a commercial and United States Department of Agriculture judge for cheese, and two United States Department of Agriculture, or other judges for milk. The products shall be judged on the following basis:

Butter		*Cheese*		*Market milk*	
Flavor	45	Flavor	45	Flavor and odor	25
Body	25	Texture	30	Sediment	10
Color	15	Color	15	Bottle and cap	5
Salt	10	Make-up	10		
Package	5				
Total	100	Total	100	Total	40

The butter, as far as practicable, shall be scored and criticised in accordance with the system outlined in Service and Regulatory announcement No. 51 of the Bureau of Markets, United States Department of Agriculture.

It shall be the duty of the judge to score each sample of the product which he is judging and write his score and criticisms on cards that will be provided. Score cards must be numbered to correspond with numbers on the packages (tubs of butter, cheese, or bottles of milk) and be signed by the judge. He may keep a memorandum of his scores and criticisms.

The score cards will be collected by clerks and the scores averaged. The average of the scores of the judges will be the "official score" for each sample respectively. Reasons of the judges will be the "official reasons."

If the score on any product varies by more than one point on flavor or more than one-half point on any other item or more than one point in total, and in case that the judges do not come within these limits, a new sample shall be submitted.

The criticisms shall agree in all particulars. Each judge shall satisfy himself that defect or other fault called attention to by the other judge is apparent to himself, or such defect should not be noted, or new sample called for in case of disagreement.

There shall be no tie scores. If samples cannot be scored off new samples shall be submitted.

The judge of market milk shall prepare regulation sediment discs, which shall be displayed in a petri dish or other suitable manner, be numbered and next to the milk samples being judged.

TO INSURE A UNIFORM STANDARD

No samples shall be open in the room at the time of scoring excepting those being judged. Uniformity shall be worked out as prescribed heretofore.

GRADING

The work of the contestants shall be graded on the following. The scores, criticisms and placing shall be graded separately but the grades shall be added to form the total for each product which shall be expressed negatively. The grades shall be established by a grading committee consisting of the superintendent of the contest and such assistants as he may select. The judges shall grade all criticisms and shall take the scores and statements into consideration when making the grade on criticisms.

BUTTER

Score

Flavor. The contestant's score on flavor will be given a grade expressed by the difference between his score and the official score.

Body. Scored as for flavor.

Color. Scored as for flavor.

Salt. Scored as for flavor.

Package. Scored as for flavor.

Placing

The score for placing shall be determined by the sum of the differences in the position of the contestant's samples and the official placing.

Total scores only will be taken into consideration. Example: If the contestant places the highest scoring example 4th, he would lose 3 points; the second highest sample 7th, he would lose 5 points and so on for all ten samples. The sum of the differences shall be the score on placing.

Criticism

The contestant shall not be graded off more than 5 on any one sample for criticism.

DETERMINING THE GRADE

A contestant's grade shall be found by adding the differences on scoring, placing and criticism. The contestant having the lowest score shall be first. A team's grade is the sum of the grades of its members. The teams are placed according to their grades, the team having the lowest score wins first place.

When two or more contestants tie or teams have the same grade, the awarding of the medals shall be decided by determining which has the highest score on flavor, then on body, then on color, then on salt, then on package. If no prize is involved, the placing shall be given as a tie.

CHEESE

Score

Flavor. The contestant's score on flavor will be given a grade expressed by the difference between his score and the official score.

Body. Scored as for flavor.

Color. Scored as for flavor.

Salt. Scored as for flavor.

Make-up. Scored as for flavor.

Placing

The score for placing shall be determined by the sum of the differences in the position of the contestants' samples and the official placing. Total scores only will be taken into consideration. Example: If the contestant places the highest scoring sample 4th he would lose 3 points; the second highest sample 7th, he would lose 5 points and so on for all ten samples. The sum of the differences shall be the score in placing.

Criticism

"Criticism" in cheese judging is graded in the same way as that described under butter judging.

DETERMINING THE GRADE

Same as for butter.

MILK

Score

Flavor and odor. The contestant's score on flavor will be given a grade expressed by the difference between his score and the official score.

Sediment. Scored as for flavor.

Bottle and cap. Scored as for flavor.

Criticism

Criticism in milk judging is graded in the same way as that described under butter judging.

DETERMINING THE GRADES AND PLACINGS

Same as for butter.

Placing of contestants on all products. The contestant whose sum of grades on the three products is lowest wins first place in judging all products.

Placing of teams on all products. The team whose sum of grades on the three products is lowest wins first place in judging all products.

Ties in placing contestants and teams on all products shall be broken in the manner described under "butter," if possible.

REPORT OF COMMITTEE ON OFFICIAL METHODS FOR TESTING MILK AND CREAM FOR BUTTERFAT

O. F. Hunziker, Chicago, Chairman

Your committee has given careful consideration to the subject of official methods of testing milk and cream for butterfat and beg to submit the following report:

1. We recommend that no changes nor modifications be made in the official and standard methods of testing milk and cream for butterfat and in the standard specifications for Babcock testing glassware, as adopted by this Association at its annual meeting in 1916 and as modified and approved by this Association at its annual meeting in 1920.

2. Your committee desires to call attention, however, to the regretful fact that there are many instances in the operation of the Babcock test where such factors as proper speed and proper temperature of the Babcock centrifuge are seriously neglected and frequently entirely ignored, thus jeopardizing the accuracy of the results.

Recent findings by H. B. Siegmund and R. Sewell Craig, published in the *Journal of Dairy Science*, volume IV, number 1, January, 1921, demonstrate anew the importance of proper speed of the tester. These findings indicate that not only is a certain minimum speed necessary to separate and assemble in the neck of the bottle all the butterfat, but the speed of the tester must be sufficient to remove from the fat column excessive admixture of water and acid.

Because of this tendency on the part of the operator to neglect the attention to proper speed and temperature of the centrifuge, your committee respectfully urges that those engaged in the instruction of testing milk and cream place special emphasis on the importance of proper speed and proper temperature of the tester, and insist that Babcock centrifuges be equipped with steam gauge (in case of steam driven machines) atuomatic speed indicator, adequate heating device, and thermometer.

3. At the last annual meeting your committee was instructed to give greater publicity to the official methods adopted by this Association. Inasmuch as the committee's report approved at last year's meeting and containing modifications of the official methods previously adopted, failed to appear in the columns of the *Dairy Science Journal*, your Committee recommends that a complete copy of the specifications for

standard Babcock glassware and of the official methods for testing milk and cream for butter fat, as adopted in 1916, and embracing the modifications adopted in 1920, be published in an early issue of the *Dairy Science Journal*, and that the 25 copies which are furnished gratis with each article, by the printers, be placed at the disposition of the Chairman of your Committee.

4. Your committee has also had under investigation methods for testing buttermilk and skimmilk for butterfat with the view of devising a method that we could recommend to this Association for adoption as a standard or official method.

As the result of this investigation and of the consideration of diverse methods of testing these by-products, your committee begs to present to this Association a method devised by Prof. Mitchell of the American Association of Creamery Butter Manufacturers. We feel that this method is a vast improvement over the ordinary Babcock Test. Its results appear to be uniform and to check closely with those of the Roese Gottlieb method. The directions given by Prof. Mitchell for the above, are as follows:

ACID-ALCOHOL TEST

Directions for testing buttermilk

Chemicals. **Commercial sulphuric acid, normal butyl alcohol.**

1. Add the chemicals and buttermilk to the test bottle in the following amounts and the order indicated.

(*a*) 2 cc. of N-butyl alcohol.
(*b*) 9 cc. of buttermilk.
(*c*) 7 cc. of commercial sulphuric acid.

Vary amount of acid to suit its strength. The right amount is being used when the fat column is golden yellow to light amber in color.

2. Mix contents of bottle thoroughly.

3. Centrifuge for six minutes.

4. Add hot water (soft or distilled) to fill bottle to bottom of neck and whirl two minutes.

5. Add balance of water to float fat into neck and again whirl two minutes.

6. Read at temperature of 135°–140°F. Double the reading to obtain per cent of fat.

7. In cleaning test bottle—especially if there be any deposit—first add a small amount of luke-warm water and to this add sulphuric acid. Always add the water first and then the acid—never the reverse. Rinse the bottle well with this mixture and then rinse with hot water.

This test gives results corresponding to those of chemical analysis.

A test bottle, with a scale reading up to 0.50 per cent for 18 grams, should be used.

We understand that butyl alcohol is to be preferred to amyl alcohol because it is comparatively easy to obtain industrial butyl alcohol free from impurities, while such is not always the case with amyl alcohol.

5. Because of the highly satisfactory results obtained by the use of the acid-alcohol test, your committee recommends that this new method be given a thorough trial, during the ensuing year, by those members of the Association who are in position to test buttermilk, and that if possible their results be reported to the Committee. While the acid-alcohol test has been worked out largely on buttermilk only, there is every indication that it will prove equally satisfactory with skimmilk. We, therefore, further recommend that this trial include skimmilk as well as buttermilk.

6. Your Committee begs to also call attention to the modified Babcock test recommended by Profs. T. J. McInerney and H. C. Troy, as published in Cornell Bulletin No. 401, January, 1920. McInerney and Troy recommend the following procedure:

1. At least 25 cc. of sulphuric acid should be used. If the size of the bottle permits, as much as 28 cc. may be used to advantage.

2. The temperature of the testing machine should be at least 180°F.

3. A centrifuge having a disk 15 inches in diameter, and strong enough to be run at a minimum speed of 1800 revolutions a minute without danger of breaking, is recommended. The diameter of the disk is determined by measuring the distance between the bases of the opposite cups when they are in a horizontal position.

4. The milk should be centrifuged for ten-, two-, and one-minute periods, instead of for five-, two-, and one-minute periods.

The above directions are given for skimmilk only.

F. W. Bouska,
L. A. Rogers,
R. H. Shaw,
H. C. Troy,
O. F. Hunziker,
Committee.

Specifications and Directions for Testing Milk and Cream for Butterfat[1]

O. F. Hunziker

I. APPARATUS AND CHEMICALS

Milk test bottle. 8 per cent 18 gram milk test bottle, graduated to 0.1 per cent. Graduation. The total per cent graduation shall be 8. The graduated portion of the neck shall have a length of not less than 63.5 mm. (2½ inches). The graduation shall represent whole per cent, five-tenths per cent and tenths per cent. The tenths per cent graduations shall not be less than 3 mm. in length; the five-tenths per cent graduations shall be 1 mm. longer than the tenths per cent graduations, projecting 1 mm. to the left; the whole per cent graduation shall extend at least one-half way around the neck to the right and projecting 2 mm. to the left of the tenths per cent graduations. Each per cent graduation shall be numbered, the number being placed on the left of the scale.

The maximum error in the total graduation or in any part thereof shall not exceed the volume of the smallest unit of the graduation.

Neck. The neck shall be cylindrical and of uniform internal diameter throughout. The cylindrical part of the neck shall extend at least 5 mm. below the lowest and above the highest graduation mark. The top of the neck shall be flared to a diameter of not less than 10 mm.

Bulb. The capacity of the bulb up to the junction of the neck shall not be less than 45 cc. The shape of the bulb may be either cylindrical or conical with the smallest diameter at the bottom. If cylindrical, the outside diameter shall be between 34 and 36 mm.; if conical, the outside diameter of the base shall be between 31 and 33 mm., and the maximum diameter between 35 and 37 mm.

The charge of the bottle shall be 18 grams.

The total height of the bottle shall be between 150 and 165 mm. (5⅞ and 6½ inches).

Cream test bottle 1. 50 per cent 9 gram short-neck cream test bottle, graduated to 0.5 per cent. Graduation—The total per cent graduation shall be 50. The graduated portion of the neck shall have a length of not less than 63.5 mm. (2½ inches). The graduation shall represent 5 per cent, 1 per cent, and 0.5 per cent. The 5 per cent graduations

[1] Published by recommendation of Committee on Official Methods for Testing Milk and Cream for Butterfat, and approved by American Dairy Science Association.

shall extend at least half-way around the neck (to the right). The 0.5 per cent graduations shall be at least 3 mm. in length, and the 1 per cent graduations shall have a length intermediate between the 5 per cent and the 0.5 per cent graduations. Each 5 per cent graduation shall be numbered, the number being placed on the left of the scale.

The maximum error in the total graduation or in any part thereof shall not exceed the volume of the smallest unit of the graduation.

Neck. The neck shall be cylindrical and of uniform internal diameter throughout. The cylindrical part of the neck shall extend at least 5 mm. below the lowest and above the highest graduation mark The top of the neck shall be flared to a diameter of not less than 10 mm.

Bulb. The capacity of the bulb up to the junction of the neck shall not be less than 45 cc. The shape of the bulb may be either cylindrical or conical with the smallest diameter at the bottom. If cylindrical, the outside diameter shall be between 34 and 36 mm.; if conical, the outside diameter of the base shall be between 31 and 33 mm. and the maximum diameter between 35 and 37 mm.

The charge of the bottle shall be 9 grams. All bottles shall bear on top of the neck above the graduations, in plainly legible characters, a mark defining the weight of the charge to be used (9 grams).

The total height of the bottle shall be between 150 and 165 mm. (5⅞ and 6½ inches), same as standard milk test bottles.

Cream test bottle 2. 50 per cent 9 gram long-neck cream test bottle, graduated to 0.5 per cent. The same specifications in every detail as specified for the 50 per cent 9 gram short-neck bottle shall apply for the long-neck bottle with the exception, however, that the total height of this bottle shall be between 210 and 235 mm. (8¼ and 9 inches), that the total length of the graduation shall be not less than 120 mm., and that the maximum error in the total graduation or in any part thereof shall not exceed 50 per cent of the volume of the smallest unit of the graduation.

Cream test bottle 3. 50 per cent 18 gram long-neck cream test bottle graduated to 0.5 per cent. The same specifications in every detail as specified for the 50 per cent 9 gram long-neck shall also apply for the 18 gram long-neck bottle, except that the charge of the bottle shall be 18 grams. All bottles shall bear on top of the neck above the graduation, in plainly legible characters, a mark defining the weight of the charge to be used (18 grams).

"Pipette, capacity 17.6 cc. of water at 20°C. Total length of pipette not more than 330 mm. (13¼ inches). Outside diameter of suction tube

6 to 8 mm. Length of suction tube 130 mm. Outside diameter of delivery tube 4.5 to 5.5 mm. Length of delivery tube 100 to 120 mm. Distance of graduation mark above bulb 15 to 45 mm. Nozzle straight. To discharge when filled with water in 5 to 8 seconds. The maximum error shall not exceed 0.05 cc. In the operation of the test the last drop of milk should be blown out of the pipette into the test bottle."

Acid measure, capacity 17.5 cc.

Cream testing scales. Sensibility reciprocal of 30 mgm., i.e., the addition of 30 mgm. to the scales, when loaded to capacity, shall cause a deflection of the pointer of at least one division on the graduation.

Weights, 9 gram weights for 9 gram test bottles and 18 gram weights for 18 gram cream test bottles, preferably stamped correct by the United States or State Bureau of Standards.

Tester. Standard Babcock test centrifuge and speed indicator.

Dividers for measuring fat column.

Water bath for cream samples, with proper arrangement for regulating and recording temperature of samples.

Water bath for test bottles, of sufficient size and with necessary equipment to insure proper control of temperature. The following dimensions for a twenty-four bottle water bath are recommended: Metal box, 14 inches long, 11 inches wide and 8½ inches deep and equipped with a bottle basket 9½ inches long and 6½ inches wide, capacity twenty-four bottles, a steam and water inlet, a drain a thermometer holder with thermometer.

Chemicals. Commercial sulphuric acid, specific gravity 1.82 to 1.83; glymol, or white mineral oil, high grade.

II. MANIPULATION OF TEST

A. Milk test

Milk samples. Single samples are preferred to composite samples. If composite samples are used they should be kept in clean jars sealed air-tight, and containing a sufficient amount of preservative. Corrosive sublimate, potassium bichromate and formaldehyde may be used as satisfactory preservatives. For the keeping of composite samples a cool location should be chosen. They should be the product of not over one week and should be tested as soon as possible.

If transported by mail, express or otherwise the sample bottle should be completely full and tightly stoppered and the samples should be preserved as above directed.

Immediately before testing the sample is thoroughly mixed until it is homogeneous. If lumps of cream, butter or ice do not completely disappear, heat to 100° to 120°F., mix thoroughly and pipette at once. Avoid incorporation of air bubbles while mixing the sample. Curdy and churned samples are not dependable.

Testing. Measure 18 grams of milk from properly mixed sample into standard milk test bottle, by using 17.6 cc. standard pipette; add 17.5 cc. of standard commercial sulphuric acid, and shake until all curd has disappeared, and then continue the shaking for a few moments longer. Milk and acid before mixing should have a temperature of 50° to 70°F.

Whirl in Babcock centrifuge for five, two and one minutes, respectively, filling the bottle with hot water (temperature 140°F. or above) to the bottom of the neck after the first whirling and to near top graduation after the second whirling. The proper speed of the centrifuge is 800 revolutions for an 18-inch diameter wheel and 1000 revolutions per minute for a 12-inch diameter wheel.

Set the test bottles into water bath and read after a temperature of 135°F. to 140°F. has been maintained for not less than 3 minutes. Read test by measuring fat column from bottom of lower meniscus to top of upper meniscus. Use dividers for reading.

B. Cream test

Cream samples. Cream samples should be tested as soon as possible and not later than three days after they are taken. Composite samples representing portions of consecutive deliveries of the same patron are unreliable. Samples should at all times be kept in nonabsorptive containers, sealed air-tight and held in the cold.

Immediately before testing mix the sample until it pours readily and a uniform emulsion is secured. If in good condition shake, pour or stir until properly mixed. If very thick, warm to 85°F. and then mix. In case of lumps of butter heat the sample to 100°F. to 120°F. by setting in water bath, mix thoroughly and weigh out at once. For commercial work on a large scale it is advisable to temper all samples to 100° to 120°F. in a water bath previous to mixing. Great care should be exercised to avoid overheating the sample, causing the cream to "oil off." This precaution is especially necessary with thin cream.

Testing. Weigh 9 grams or 18 grams, respectively, of the properly mixed sample into a standard cream test bottle on standard cream testing scales which are in proper working condition, set level and are protected from drafts.

Method I. Add standard commercial sulphuric acid until the mixture of acid and cream, immediately after shaking, resembles in color, coffee with cream in it. Usually about 8 to 12 cc. of acid is required in the case of the 9 gram or 14 to 17 cc. of acid in the case of the 18 gram bottle, the amount needed depending on the temperature of acid and cream and on the richness of the cream.

Whirl in Standard Babcock centrifuge at proper speed, five, two and one minutes, respectively, filling the bottles with hot soft water, temperature 140 F. or above, to the bottom of the neck after the first whirling and to near the top graduation after the second whirling.

a. Alternate Method. Add 9 cc. of water after the cream has been weighed into the test bottle and before the acid is added, then add 17.5 cc. acid and proceed as in previous method. This method is applicable with the 9 gram bottle only.

b. Alternate Method. Add 8 to 12 cc. of acid in the case of the 9 gram bottle or 14 to 17 cc. of acid in the case of the 18 gram bottle, or add acid until the mixture of cream and acid, after shaking, has a chocolate brown color. After the cream and acid have been thoroughly mixed and all lumps have completely disappeared, add a few cubic centimeters (not less than 5 cc.) of hot soft water, whirl five minutes, add hot soft water to near top of scale and whirl one minute.

The proper speed of the centrifuge is 800 revolutions per minute for an 18 inch diameter wheel and 1000 revolutions per minute for a 12 inch diameter wheel.

Set the test bottles into water bath and read after a temperature of 135°F. to 140°F. has been maintained for not less than three minutes, add a few drops of glymol and read at once, preferably using dividers. Experienced testers are able to secure correct readings without glymol by reading to the bottom of the upper meniscus but the use of glymol is urged.

C. Defective tests

The fat column of the finished test should be clear, translucent and should have a golden yellow to amber color. All tests which are milky, or foggy, or showing the presence of curd or charred matter in or below the fat column, or of which the reading is indistinct or uncertain, should be rejected. Duplicate tests are essential in all work where special accuracy of results is required, such as in official testing and experimental investigations.

REPORT OF COMMITTEE ON RELATION TO BREED ASSOCIATIONS

E. G. Woodward, Washington, Chairman

1. Report of Sub-Committee on Administration of Official Testing Work Within the Various States

A. Office records. These consist of (a) duplicate copies of all test reports to be filed at College under name of owner and name or H. B. number of cow. (b) Card or book record showing supervisor assigned, date of test and its length, cows reported, reports sent to club, and charge against breeders. (c) Markers or lists showing delinquent breeders or records needing special attention. (d) Ledger accounts with breeders and cattle clubs, cost sheets, vouchers, etc., appropriate to accounting system in use at the respective institutions. (e) Statistical data forms.

Recommendations. It is hardly necessary to say that each institution ought certainly to maintain a complete file of original test sheets. The clubs rightly expect this of us. Our system of office checking should be designed simply and should be so direct that the records will not be delayed in transmission. We advise that the committee take up with the clubs the question of forms to be furnished for billing check tests, etc., with a view to uniformity. It would also be worth while if some of us should be designated to receive samples of new forms or improvements devised by our members and to circulate suggestions among others. It has been suggested that uniform blanks be designed for use in the various States which could be printed in quantity and distributed from some central point. There would be some difficulty in financing such an arrangement. A committee could be appointed, perfect plans and get tentative bids if a sufficient number of States are interested.

B. Training supervisors. Results from special courses are reported disappointing in most cases. The number secured by this means is so small as to hardly pay for the time spent in giving the instruction while the quality is no improvement. The committee believes that better results are secured at no greater cost through personal coaching of candidates before first assignment, where they have taken their training in some college or secondary school course. Candidates may better be selected on basis of moral character, reputation in home community,

intelligence, experience, and general appearance and bearing, than to depend too much on training alone.

C. District organization. Indiana, Illinois and Wisconsin have attempted to coöperate in maintaining a supply of well-trained supervisors while avoiding the embarassment of a surplus. Under such circumstances as have existed the past four years, the plan has worked well. At our present stage of development, we found it hardly practicable to include more then two states in such district. We worked informally. Our experience indicates that districts should be laid out in squares or with greatest length north and south, so that busy seasons in different sections will fall at different times. All members of a district must hold to similar standards and should try to have details of practice conform in so far as possible. The institution acting as clearing house to a large district ought to be centrally located.

D. Cattle clubs. It is hardly conceivable that the cattle clubs would be able to take over the administration of advanced registry work at the present time or in the very near future. Impaired financial condition, internal politics and mutual jealousies, all operate against a change in that direction now. It would seem to be quite feasable for the breed organizations to jointly take over and carry advanced registry testing sometime in the future. The committee on relations may well have this possibility in mind. Meanwhile, the colleges and experiment stations seem to be the most logical as well as competent instruments for the job, so can hardly shift the responsibility.

2. Report of Sub-Committee on Uniform Rules for the Conduct of Official Records of Dairy Cows

Rules must be followed. 1. The supervisor is not at liberty to decide as to which stipulations contained herein are essential and which are not, but is required to observe these directions in all details.

Relationship of supervisor. 2. The supervisor shall bear in mind at all times that he is in the employ of the agricultural college or experiment station of the State employing him and that he is not in any way working for the owner of the cow on test or for the breed association. The *only interest* that the supervising institution has in the test is that it shall be honestly and accurately made and the agricultural college or experiment station supervising said test *insists* that this be done.

Identity and condition of cow. 3. The supervisor shall satisfy himself as to the identity of each cow under test. Certificates of registration or authorized official diagrams of color markings must be presented

for the identification. Animals not having distinctive markings indicated on registration papers must be tattooed in the ear with such letters, characters or numbers as the owner may adopt. These identification marks must be recorded with the breed association and the institution as well. All animals which cannot be identified under the above rules must be reported as unidentified. Complete identification is of the utmost importance and *must not be neglected.* The supervisor shall note upon his report form any sickness of a cow or other condition likely to affect the reliability of a test. He shall also report any irregularity or suspicious occurrence.

Unidentified cows. 4. Unidentified cows are allowed to be placed on test, the institution however, assuming no responsibility as to the identity of the animal—this matter must be attended to between the the owner and the breed association. Test reports of unidentified cows must be accompanied by color sketch or description of the cow so tested.

Possessor considered owner. 5. For all purposes of official testing work, the possessor is considered the owner and is required to treat the animal as such, presenting all necessary data, the same as for his own.

Preliminary milkings. 6. Preliminary milkings are required. The supervisor shall be present at the last regular milking preceeding the beginning of the test, and shall see that the cow is milked dry. He shall note the hour that this milking is made, and the last milking of the test shall be made at the same hour.

Seeing the cow milked. 7. The supervisor shall be present at and throughout each and every milking during the test period and shall see that the pail contains nothing but the milk drawn from the cow under test. Before each milking period, the supervisor shall observe that the milk pail is free from grease or other fatty substance and the supervisor shall carry the milk pail at all times during the milking period, allowing the pail out of his hands only after the milker is seated, ready to begin milking, and during the actual milking process. Under no circumstances shall more than one cow undergoing test be milked at the same time and the supervisor must in every case be in position to observe the milker during the entire milking process.

a. Milking machines. Where a milking machine is used, no second man as stripper is allowed. The milking machine is to be run idle for a few moments before attaching to the cow to insure that no milk is coming from another source. Only one cow shall be milked at a time, the same as in hand milking.

b. Right of search. The supervisor has the right to search the milker at any time and to require milkers to roll sleeves up to the elbows. Refusal on the part of the milker will be construed as evidence of intent to make a fraudulent test.

Weighing milk. 8. The supervisor shall assure himself as to the accuracy of the scales used, checking those of the owner with those provided by the institution, these being graduated to pounds and tenths ($\frac{1}{10}$) of a pound. He shall weigh the empty milk pail before each milking, retaining possession of the pail until the milker is seated and ready for milking. After each milking is completed he shall weigh the same immediately and record the exact weight of the milk in his field notes and also see that the correct weight is recorded upon the owner's barn record. The pounds of milk must be recorded in one decimal, as 14.5 pounds. Any inaccuracy in the owner's scale shall be reported to the breed association and to the superintendent of official testing in the State concerned.

Sampling milk. 9. The supervisor shall take a sample of the milk of each milking immediately upon the weighing of the milk, being careful that the milk is thoroughly mixed by pouring from one pail to another at least twice to insure a fair sample of the whole—the owner being required to provide an extra pail for this purpose. Such samples (properly labeled) must be securely retained until tested, under the absolute control of the supervisor, either being in his actual possession or securely locked in the testing case provided. The samples must be tested as soon as convenient after the samples have cooled to ordinary room temperature, which is 60–70°F. When the last samples at night are kept until morning, in warm weather preservatives should be added to each sample.

Applying the Babcock test. 10. The supervisor shall apply the Babcock test to the milk of every milking during the test period, making a separate test in duplicate of each milking. He shall determine the percentage of butter fat in each sample, making a duplicate test of each milking and recording the same. Should the duplicate tests of each sample of milk vary more than two-tenths of one per cent (0.2 per cent), the testing of the sample of milk must be repeated. If the variation is 0.2 per cent or less, then the average of the duplicate tests shall be used in figuring the amount of butter-fat in the sample of milk. Readings of the test bottles shall be made at 130 to 140°F. This temperature shall be obtained by placing the bottles in a hot water bath for five minutes before reading the tests. The supervisor shall record these

readings immediately in his field notes. Samples taken at any one milking shall not be thrown away until satisfactory duplicate tests of the milking are obtained.

Lost milk and lost samples. 11. No substitution of lost milkings or lost samples is allowed. The supervisor shall report that portion of the test for which *exact* data is at hand. Any missing data due to loss of milk weights or test samples are to be left blank on the report.

Report of high production. 12. When the following production requirements in a two day (forty-eight-hour) test period have been exceeded, a special report of the same must be made to the state superintendent of official testing.

	Pounds of fat
Junior 2-year old	4.0
Senior 2-year old	4.4
Junior 3-year old	4.8
Senior 3-year old	5.2
Junior 4-year old	5.6
Senior 4-year old	5.8
Mature	6.0

Preliminary reports. 13. A preliminary report card shall be mailed by the supervisor from the farm to the breed association immediately after the test.

Reports of supervisors. 14. The supervisor shall sign his reports and mail them promptly to his appointing officer for checking and endorsement.

Number of milkings allowed to be supervised at one time. 15. No supervisor is allowed to supervise more than (24) twenty-four milkings per day, without special permission from the state superintendent of official testing, unless all cows under test are milked twice daily, when a limit of thirty milkings is permissible.

Test periods exceeding two days. 16. Where a test is conducted longer than the regular two days or where more than one test is made in a month, all details of each test from beginning to end must be reported.

Payment of supervisors. 17. Under no circumstance shall any payment, gift, or gratuity to the supervisor be made by, or permitted from the owner of the cow or any one interested in her and any violation of this rule will invalidate the test.

Supervisors to supervise tests. 18. The supervisor appointed to conduct a test is the direct representative of the Superintendent of Official Testing and needs to be treated in all respects as though he were the appointing officer in person. His duties are to supervise tests only.

Sworn statements. 19. Each supervisor is required to fill out a sworn statement covering all his work which eliminates the necessity of his affirming test reports.

Responsibility for enforcement of rules. 20. Owners, and persons in their employ, are held equally responsible with the supervisor for the enforcement of the foregoing rules.

APPENDIX TO INSTITUTION RULES GOVERNING THE CONDUCT OF OFFICIAL TESTS

A. Steps in the Babcock test of whole milk

1. Temper sample of milk to 60–70°F.

2. Mix thoroughly by pouring from one bottle to another three or four times—never shaking samples.

3. Pipette 17.6 cc. milk, taking a duplicate test.

4. Add 17.5 cc. sulphuric acid, adding more than 17.5 cc. acid if acid is weak and less if strong. Desired color being a light coffee color.

a. Strong acid causes charing of the solids not fat; dark fat columns; specks in the fat column.

b. Weak acid leaves undissolved particles at base of fat column; very light colored fat column; grayish or white particles in fat column.

5. Whirl at proper speed for five minutes, usually eighty revolutions of handle per minute.

6. Add hot water (170–180°F.), bringing fat to neck of bottle. Above temperatures apply to hand testers.

7. Whirl two or three minutes.

8. Add hot water (1.80°F.), bringing the fat column to the 7 per cent mark. Above temperatures apply to hand testers.

9. Whirl one or two minutes.

10. Place water bath of 130–140°F. for five minutes.

Be sure entire fat column is surrounded with the hot water.

11. Read from bottom of fat column to extreme top of fat column, using dividers for this purpose.

B. Recording tests

In recording tests use the following system: The percent of fat to be recorded in one decimal, as 3.2 per cent, except where a difference of 0.1 per cent exists between duplicates, when the percent of fat shall be recorded in two decimals (3.2 per cent–3.3 per cent) 3.25 per cent. The pounds of fat shall be recorded in three decimals, as 0.345 pounds of fat and in case the fourth decimal is five or above, add one to the third decimal, as 0.3456 will give .346 pounds fat.

C. Cautions

1. Label samples and tests of samples so that no possible confusion may ensue.
2. Accept only accurate clear cut fat columns.
3. Watch temperatures—use your thermometer—never guess temperatures.
4. Avoid unnecessary breakage of glassware.
5. Keep glassware scrupulously clean. Clean equipment at the close of every test.

D. Determining fat percentage

The average percentage of fat shall be determined by dividing the total yield of fat for any test period by the total yield of milk for the same test period. It should be recorded in two decimal places as 3.27 per cent. In case the fourth figure in the division is five or above, then add one to the third figure, as 3.267 would give 3.27 per cent.

RECOMMENDATION TO STATE SUPERINTENDENT OF OFFICIAL TESTING

Number of supervisors required. 1. Not less than three (3) supervisors are required on every yearly test.

3. Report of Sub-Committee on Methods of Financing Official Testing

We recommend:

1. The adoption of the flat rate

(1) That each state adopt the flat rate method, that is, make a per day or per test charge that will cover all the charges for test supervision.

(2) That the amount of this charge be decided by each State according to local conditions, such as the local price of labor, number of herds under supervision, the particular system of supervision being used and the amount of travel and hotel charge that may be required in connection with the supervision.

The following are advantages of the flat rate method of charging:

(1) It equalizes the expense to the breeders. Breeders living at great distance pay no more than breeders living close to the college.

(2) It greatly simplifies the keeping of advanced registry accounts.

(3) It avoids misunderstanding with the breeders.

(4) The breeder knows in advance exactly what it will cost to conduct any given test.

(5) Supervisors knowing the limits to which they are held will be more careful in incurring expenses.

2. Charges should cover the cost of advanced registry supervision

We believe that the department or agency of the college or experiment station, under which the supervision comes is justified in making the charge to the breeder large enough to cover all of the expenses incurred in supervising advanced registry tests as follows:

(1) Telephone and telegraph.
(2) Stationary and office supplies.
(3) Office equipment—supervisor's equipment.
(4) Salary of superintendent.
(5) The salaries of all clerical force and assistants necessary in checking and reporting the records.
(6) Salary or wages of supervisors.
(7) Travelling expenses of supervisors.
(8) Notary fees.

3. The breed association should collect from the breeder

(1) A copy of the statement of charges for any given test should be mailed to the cattle club concerned.
(2) That the cattle club shall remit within 30 days to the college.
(3) That a duplicate copy of the statement be kept in the office files.

The advantages of having all bills paid by the cattle clubs are:

(1) It protects the colleges or experiment stations against financial losses.

(2) It removes the necessity of direct financial dealing with the breeder which (*a*) will eliminate disagreements and (*b*) enable the college or station to fix adequate charges for financing advanced registry testing.

(3) It simplifies the accounting.

(4) It insures the supervisor of prompt payment in states where they are paid after collections are made from the breeders for whom they tested.

ROY T. HARRIS,
W. W. YAPP,
H. N. COLMAN,
J. B. FITCH,
WM. J. REGAN,
G. C. WHITE,
E. G. WOODWARD,
Committee.

CONFERENCE WITH REPRESENTATIVES OF BREED ASSOCIATIONS

ROY T. HARRIS, *Secretary of the Conference*

This conference of the committee on relation to breed associations of the American Dairy Science Association with representatives of the Breed Associations was held at the Hotel Harrington, Washington, D. C., December 20, 1921.

Those present were: O. H. Baker, A. J. C. C., C. L. Burlingham, A. C. B. A., Wm. H. Caldwell, A. G. C. C.; M. H. Campbell, Illinois; W. W. Fitzpatrick, Clemson College, South Carolina, M. H. Gardner, H. F. Assoc.; R. M. Gow, A. J. C. C.; Roy T. Harris, Wisconsin; W. M. Regan, New Jersey; G. C. White, Connecticut; E. G. Woodward, Washington.

The purpose of the conference was primarily to place the financial phase of test supervision on a more satisfactory basis. This was clearly stated by Chairman Woodward and Mr. Regan. It immediately developed that each representative of a breed association present was there to assist in the solution of problems which have for a long time bothered the superintendents in the various states and which have led to much misunderstanding and friction. The committee opened negotiations in the spirit of seeking to clear up matters for the good of all.

It was voted as the sense of this conference that the financing of the advanced registry and register of merit work is a responsibility of the breed associations and not of the institutions. All were pretty thoroughly agreed on this point.

After considerable discussion of various schemes which proved more or less objectionable or impracticable, Secretary Caldwell announced the action of his executive committee accepting the plan recommended by the American Dairy Science Association and agreeing to place same in effect at once. This was followed by statements from Secretary's Burlingham and Gow promising endeavors to secure similar action at the next meeting of their respective boards in January, 1922. Secretary Gow invited Messrs. Regan and White to present the American Dairy Science

Association plan to the board meeting of the American Jersey Cattle Club. This was agreed to. Superintendent Gardner pointed out some obvious difficulties in the way of the application of this plan to his association, but agreed to present it to his board. This cannot be done, however, before June, 1922. It was agreed by all that the arrangement could only apply to states having a flat rate for tests.

Breed representatives described the unsystematic methods of billing accounts by some institutions and urged that colleges make a very serious effort to arrive at more uniformity and careful attention to such details. It is agreed that when club forms are furnished, we should use them so far as possible.

Some objection developed to including salary of superintendent as legitimate item of expense of supervision, it being urged that if this is done, he becomes an employe of the breed associations, both in law and fact. No action taken as outside jurisdiction of our conference.

Uniform blanks for reporting one and two day tests of semi-official cows are desirable and have long been urged by the American Dairy Science Association. Secretary Gow made a motion expressing the sense of the conference in favor of the desirability of uniform blanks for reporting such tests which was carried without dissent. After some discussion Mr. Baker of the American Jersey Cattle Club and Mr. Regan of New Jersey were appointed as a committee to work out details of forms to be submitted for approval, or blue pencil, to the parties interested and to devise satisfactory means of printing and distributing the forms to the colleges. It is hoped that the new arrangement will be in effect by the beginning of the next testing year.

The rules for control of test supervisors in the field adopted by the American Dairy Science Association at the St. Paul meeting were submitted to the conference for criticism and suggestion. Some changes in wording were made to meet these, but none affect the essential requirements. If these are approved by the executive committee, they will become the official wording. Advanced registry superintendents in the various states

who have not secured a copy of the new rules may do so by addressing the secretary.

It was re-affirmed as the sense of this conference that the breed associations should accept the rules adopted by the American Dairy Science Association as the official test rules and should publish these as such or not publish any. This in so far as the actual supervision of the tests is concerned. The basis for advanced registration and requirements for entry are strickly breed affairs and subject only to suggestion on the part of the institution.

With the view to assist the breeds represented in harmonizing their practice somewhat several points of difference were discussed. Motions were passed favoring a rule that milk records should not begin earlier than the fourth day after calving and official test periods not earlier than the seventh day after calving counting day of calving as the first day. Another stating as the sense of the conference that all advanced registry and registry of merit records be made in one lactation period was also passed.

The conference adjourned confident that real progress had been made and that the institutions and breed organizations have both benefited through the better understanding at which we arrived.

Recommended Method of Handling Advanced Registry Testing Accounts

The breed association should collect from the breeder.

1. A copy of the statement of charges for any given test should be mailed to the cattle club concerned.
2. That the cattle club shall remit within 30 days to the college.
3. That a duplicate copy of the statement be kept in the office files.

The advantages of having all bills paid by the cattle clubs are:

1. It protects the colleges or experiment stations against financial losses.
2. It removes the necessity of direct financial dealing with the breeder which (*a*) will eliminate disagreements and (*b*) enable the colleges or station to fix adequate charges for financing advanced registry testing.
3. It simplifies the acccounting.
4. It insures the supervisors of prompt payment in states where they are paid after collections are made from the breeders for whom they tested.

REVISED CONSTITUTION FOR THE AMERICAN DAIRY SCIENCE ASSOCIATION

Article 1. The name of the organization shall be the American Dairy Science Association.

Object

Article 2. The object of the Association shall be to advance the general welfare of the dairy industry, especially the improvement of dairy instruction, by the stimulation of scientific research in all phases of the subject and by improvement in methods of conducting extension work.

Membership

Article 3. Membership shall be of only one kind, namely: Active.

Article 4. The following are eligible for election:

(1) Any person who is formally announced by an agricultural college, or experiment station or by the Dairy Division of the United States or Canadian Departments of Agriculture as an instructor, extension worker, investigator or administrative officer connected with the dairy industry, or anyone filling a position of responsibility connected with the dairy industry and who has had a college or university training in technical science, or anyone filling a responsible position in the industry of a professional character requiring a technical knowledge of dairying of a high order.

Article 5. Nominations for membership shall be submitted to the executive committee in written form and signed by at least three members. Upon receiving the unanimous endorsement of the executive committee and paying the annual membership dues, the candidate shall be duly enrolled as a member of the Association.

Officers

Article 6. The officers of this Association shall be president and vice-president, whose term of office shall be one year; a secretary-treasurer and a *Journal* editor, whose term of office shall be two years. The term of office shall begin January 1.

The president, the vice-president and the secretary-treasurer and the presiding officers of the divisions of the Society shall constitute the executive committee.

Duties of officers and manner of election

Article 7. The duties of the officers shall be those usually pertaining to their respective offices. The executive committee shall pass upon all nominations for membership, all applications for divisions and sections of the Society. It shall have the power to fix the time and place for the annual meeting and shall be authorized to transact such business of the Association as demands attention while the Association is not in session.

Article 8. On or before November 1, the secretary shall mail to each member a blank on which he shall be entitled to express his choice for each office to be filled. This blank shall give the names of those serving in the offices to be filled for five years preceding and a report of the committee on elections which shall suggest the names of two members for each office to be filled. All ballots shall be counted by the secretary and later verified by the president. In case no candidate has a majority by the first ballot, a second ballot shall be sent to the members, giving the names of the three leading candidates for each office and the number of votes received. The candidates receiving the most votes on the second ballot shall be declared elected. In case of tie on the second ballot, the decision shall be made by the executive committee.

Organization of divisions and sections

Article 9. Professional groups based upon geographical considerations to be known as divisions of the Society and to be organized by members of the Association may be authorized by the executive committee when such action shall seem expedient. The officers of the division shall be chairman and such other officers as are provided by the division. The presiding officers of division shall be ex-officio vice-presidents of the Society.

The divisions shall have the right to make by-laws for their own government and which shall not be inconsistent with the constitution and by-laws of the Association.

Membership in divisions of the Society is open only to those regularly elected members of the Society.

Any division may raise or collect funds to be expended for its own purpose.

Article 10. Professional groups based upon specialized interests to be known as sections of the Society and to be formed by not less than 10 active members, may be authorized by the executive committee when considered for the best interests of the Association.

Such sections may elect their own officers and may make any rules for their own guidance not inconsistent with the constitution and by-laws of the Association.

Amendments

Article 11. The constitution may be amended by a two-thirds vote at any regular meeting of the Association; provided the proposed amendments have been submitted to the executive committee in writing not less than 30 days previous to the meeting at which the vote is taken; and provided the proposed amendment is approved by a majority of the executive committee.

Article 12. The executive committee may, at its discretion, submit proposed amendments which have received the approval of the committee to the members of the Association for vote by mail. An affirmative vote of two-thirds of all voting and which shall be not less than a majority of the membership shall be necessary for approval.

By-laws

Article 1. The membership dues shall be $5.00 a year, payable January 1, each year.

Article 2. The *Journal of Dairy Science* shall not be sent to any member whose dues are not paid by April 11 of the year for which the Membership is held.

Article 3. Any members in arrears for dues for more than one year shall thereby cancel membership but may be restored to membership without any action by the Society by payment of all arrears including dues for the current year.

Article 4. The time and place of the meetings of the Society shall be fixed by the executive committee.

Article 5. A quorum at any meeting for the transaction of business shall consist of not less than 10 per cent of the active members.

Article 6. A committee of five on elections shall be appointed by the president. Said committee shall make a report at the annual meeting in which the names of two members shall be suggested for each office to be filled by mail ballot under the provision of the constitution. In addition thereto, a group of five or more members may suggest other names for consideration but such requests shall be in the hands of the secretary of the Association before November 1.

Article 7. In conducting mail ballots, only those ballots shall be counted which are received by the secretary within four weeks from the date upon which the ballots were mailed by the secretary.

Article 8. Section Meetings. The time and place of meeting for the Sections of the Association shall be fixed by the executive committee. All other arrangements regarding the section meetings shall be made by the officers of the section.

Article 9. These by-laws may be amended at any regularly called meeting by a two-thirds vote of those present.

AMERICAN DAIRY SCIENCE ASSOCIATION

Organization for 1922

President.....C. H. ECKLES, University Farm, St. Paul, Minn.
Vice president.....A. A. BORLAND, State College, Pa.
Secretary-treasurer.....J. B. FITCH, Manhattan, Kans.
Editor.....J. H. FRANDSEN, Lincoln, Nebr.

EASTERN DIVISION

Chairman.....R. C. FISHER, Storrs, Conn.

STANDING COMMITTEES REPORTING TO THE GENERAL MEETING

Membership

J. A. GAMBLE.....Maryland, *Chairman*
H. F. JUDKINS.....Massachusetts
W. H. E. REID.....Missouri
V. D. CHAPPELL.....Oregon

Bacteriological methods for market milk

R. S. BREED.....New York, *Chairman*
L. A. ROGERS.....Dairy Division, U. S. D. A.
J. D. BREW.....New York
E. G. HASTINGS.....Wisconsin
B. W. HAMMER.....Iowa

SECTION 1. DAIRY PRODUCTION

Chairman.....W. M. REGAN, Experiment Station, New Brunswick, N. J.
Secretary.....E. L. ANTHONY, Morgantown, W. Va.

STANDING COMMITTEES

Dairy cattle judging contest

W. W. SWETT.....Missouri, *Chairman*
E. L. ANTHONY.....West Virginia
J. B. FITCH.....Kansas
H. H. WING.....New York
H. H. KILDEE.....Iowa
E. V. ELLINGTON.....Dairy Division, U. S. D. A.
W. M. REGAN.....New Jersey

SECTION 2. DAIRY MANUFACTURES

Chairman.....L. A. ROGERS, Dairy Division, U. S. D. A.
Vice chairman.....C. L. ROADHOUSE, California
Secretary.....H. A. RUEHE, Illinois

STANDING COMMITTEES REPORTING TO SECTION 2

Score card for dairy products and legal standards

J. H. FRANDSEN.....Nebraska, *Chairman*
H. B. ELLENBERGER.....Vermont
S. C. THOMPSON.....Dairy Division, U. S. D. A.
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L. A. ROGERS.....Dairy Division, U. S. D. A.
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BITTER MILK OF ADVANCED LACTATION[1]

A LIPASE FERMENTATION

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Bitter milk is ascribed most commonly to specific bacteria, of which several species have been described by various investigators (1). Less commonly a diseased condition of the udder (2) or the eating of certain weeds, such as rag weed, causes the milk to be bitter. The two latter causes are distinguished from the first in that the milk is bitter when drawn, whereas bitterness due to bacterial fermentations develops after the milk is secreted. Still another type of bitter milk is associated with advanced lactation. This type was described in some detail by Eckles and Shaw (3) in the case of several cows under experimental conditions where the feeding conditions and care and handling of the milk were uniform. As described by these investigators the milk developed a strong rancid odor, suggestive of butyric acid within twenty-four hours after it was drawn from the cow. This odor was accompanied by a very bitter flavor. It was observed that these conditions developed also in the cream separated from the milk. In neither case did the addition of formalin to the fresh products prevent the development of the abnormal flavor and odor. Extreme difficulty of churning the cream also accompanied these conditions.

That the conditions described by the aforementioned writers are not uncommon in the commercial production of milk is indicated by their statement that "numerous inquiries are received each year regarding abnormal flavor in milk from cows near the end of the lactation period." The writer's attention

[1] Published with the approval of the Director as Paper No. 282, Journal Series, Minnesota Agricultural Experiment Station. The investigation reported in this paper was begun by the author at the Missouri Agricultural Experiment Station and carried to completion and prepared for publication at the Minnesota Agricultural Experiment Station.

was called to the question of the cause of this abnormality because of the numerous inquiries received regarding it. An examination of these inquiries shows also that almost invariably the inquirer has only one or two cows, indicating that the conditions described are not necessarily of great practical importance in dairies or for market milk.

The present paper describes an experimental study of the cause of the so-called bitter milk of advanced lactation. This inquiry has been continued over a period of several years because it has been necessary to study the problem when typical cases were so available that the handling of the samples of milk could be rigidly controlled. Unfortunately for the rapid completion of the study most of the inquiries received were from persons located so that an experimental study of the milk was not possible.

It is believed that sufficient data have now been secured to warrant the conclusion that the immediate cause of the abnormal flavor and odor of milk of certain cows whose period of lactation is more or less advanced is the secretion of an abnormal quantity of lipase in the milk. The proof for this will be furnished below. It will be shown that it is not possible to transfer this condition by inoculation from typical "bitter milk" of this type to normal milk. It will be shown, also, that such milk exhibits an abnormal lipase activity even under bacteriologically sterile conditions. Finally it will be shown that milk which will develop this abnormal flavor and odor can be prevented from so doing by heating to a temperature which is ordinarily regarded as destroying lipase activity.

While the experimental results reported below are believed to show that the immediate cause of the bitter flavor and rancid odor of milk from cows in advanced lactation is an active lipase in the milk, the author has not as yet gone back of this question to ascertain the physiological explanation for the presence of this lipase. Numerous studies which the writer carried out on the normal presence of lipase in cow's milk in connection with this investigation, which were reported in a preceding paper (4),

showed that cow's milk does not normally contain a true lipase. It is generally believed that an active lipogenesis occurs in the mammary gland during lactation. This theory presupposes the presence of a lipase in the udder cells. It is not surprising, therefore, that this enzyme should, at times, occur in the milk. In fact, it is surprising that an active lipase does not occur in milk normally. Inasmuch as lipase is apparently absent under normal conditions, the physiological problem to be solved in the case of the bitter milk of advanced lactation is the factor underlying its appearance at this particular time. It is clear that the conditions causing its appearance do not occur for all cows at the close of lactation. Advanced lactation, therefore, is not in itself the primary cause. Obviously the whole matter is much more deep seated, and statements which may be advanced to explain the phenomenon can only be speculative. The problem is worthy of further investigations, which the author hopes later to undertake.

One of the striking phenomena which frequently accompanies the abnormal fermentation described is the extreme difficulty of churning the cream from the milk. This condition was pointed out by Eckles and Shaw (3) and inquiries as to a remedy for the difficulty often accompany requests for information regarding bitter milk. The principal characteristic of the cream in these cases is excessive foaming. This, of course, is the primary cause of the difficult churning. It was observed in the course of these studies that the milk itself also foams very readily when shaken and that this property increases as the milk becomes more rancid. This observation indicates that the difficulty of churning is directly connected with the fermentation which causes the rancid odor and bitter flavor and is no doubt caused by the formation of soaps which accompanied the liberation of free fatty acids during the lipolytic fermentation. It is recognized, also, that this cause of the difficult churning is augmented by the conditions which usually render churning more difficult at the close of lactation, namely, higher protein content and smaller fat globules.

EXPERIMENTAL

Bacteria as possible cause of abnormal fermentation

Three cases of bitter, rancid milk were examined particularly with the view of determining whether the abnormal fermentation could be transmitted from the bitter product to fresh, sweet milk or cream. In each case only a single cow was involved and the milk and cream showed the characteristics mentioned to a marked degree within ten or twelve hours after milking, even when kept cold. Great difficulty of churning accompanied the conditions in one case. Observations regarding this difficulty were not made in the other two cases inasmuch as the milk was used only for consumption as whole milk and cream.

The procedure for examining the transmission of the fermentation was essentially the same in each case and consisted of inoculating separate samples of freshly pasteurized sweet cream with increasing amounts of the bitter, rancid product, beginning with 1 drop and ending with 5 cc. to 7 cc. In some cases 15 cc. of the sweet cream were used and in other 17.6 cc. In all cases the inoculated material was kept in 50 cc. Erlenmeyer flasks, stoppered with a cotton plug. Observations as to odor and flavor were made at intervals of twenty-four and forty-eight hours after keeping the samples at room temperature or 38°C. In the tests with one sample of rancid milk a set of samples was kept at 5–8°C., also, and one sample was incubated at 38°C. in which 7 cc. of the bitter rancid milk were heated to 72°C. before adding it to 17.6 cc. of sweet cream.

It does not seem necessary to report the protocols of the several tests inasmuch as the results were uniform throughout. Inoculations with 1 or 2 drops uniformly failed to produce the rancid odor and bitter flavor under each of the temperatures employed. When 5 cc. or more of the rancid milk were added to 15 cc. to 17 cc. of sweet cream more or less of the characteristics of the original product developed on standing. The most striking results were secured in all cases when the largest amount (7cc.) of the rancid material was added and when the temperature of the mixture was maintained at 38°C.

The results of these tests indicated clearly that the origin of the fermentation is not bacterial but enzymatic since the characteristics of the original product fail to develop on dilution of the causative factor and also fail to develop on inoculation with amounts which would cause the fermentation if bacteria were responsible. In the single case where the original product was added in large amount (7 cc.) after heating to 72°C., the fermentation also failed to develop, even at 38°C.

Attention should be called also to the fact that the rancid odor and bitter flavor of each of the original products used for inoculation of the sweet cream were strongly suggestive of the development of butyric acid. In fact, when fresh milk was treated with a small amount of an aqueous solution of butyric acid the milk become so nearly identical in flavor and odor with the naturally rancid milk that several observers found it impossible to distinguish between the natural and artificial products. It was this observation, especially, together with the results of the inoculation tests, which led to an examination of the lipolytic activity of the subsequent samples of bitter milk secured for investigation.

Lipolytic activity of bitter milk

The study of the lipolytic activity of the bitter milk of advanced lactation was conducted with three samples secured at separate times. One of these was the third case reported above for a possible bacteriological origin of the fermentation. In each case a single cow, only, was involved. The experiments on this phase of the problem will be reported separately.

Experiment 1. The milk was received from the owner of the cow in two portions. One portion was raw milk to which 1.5 per cent chloroform had been added to the fresh milk by the owner. The other portion had not been so treated but had been heated while fresh to 75°C. Both portions were about seventy hours old when the experiment was begun. At this time the portion treated with chloroform had the characteristic rancid odor and bitter taste in spite of the chloroform present. The heated portion showed neither of these properties.

Four 50 cc. portions of the raw milk were placed in 200 cc. Erlenmeyer flasks and 25 cc. of freshly boiled and cooled distilled water added to each flask, together with 1 cc. of neutral, saturated potassium oxalate solution. Two of these flasks were then heated to 78°C. and cooled at once. Two similar flasks were prepared containing the milk which had been heated by the owner of the cow. 1 cc. of chloroform was now added to flasks 1 and 2, containing the raw milk, and 1.5 cc. to the remaining 4 flasks. After adding 5 drops of 1 per cent alcoholic phenolphthalein solution to each flask all were titrated to a faint pink with 0.1 N aqueous NaOH solution. The titrations were repeated after 2 successive twenty-four hour intervals, the flasks being kept at 37°C. The results are shown in table 1, after calculating to 100 cc. of milk.

TABLE 1

Lipolytic activity of bitter, rancid milk, experiment 1

FLASK	TREATMENT OF MILK	INITIAL ACIDITY*	ACIDITY* AFTER 24 HOURS	ACIDITY* AFTER 48 HOURS
		cc.	cc.	cc.
1	$CHCl_3$ added when fresh	33.2	5.60	2.50
2	$CHCl_3$ added when fresh	32.6	5.84	2.70
3	$CHCl_3$ added when fresh	31.4	2.76	1.20
4	Heated to 72°C. after 70 hours	32.0	2.30	1.24
5	Heated to 72°C. when fresh	14.4	3.00	1.76
6	$CHCl_3$ added after 70 hours	14.4	3.10	1.60

* Cc. 0.1 N acid per 100 cc. milk.

The striking features of the data shown in table 1 are first, the high initial acidity of the milk in flasks 1 to 4 to which a bacterial antiseptic had been added which does not inhibit lipase activity[2] in comparison with the inital acidity of the milk in flasks 5 and 6 which had been heated when fresh to the thermal death point of lipase; second, the much greater development of acidity in flasks 1 and 2 which were not treated further before incubation in comparison with that which developed in the remaining (flasks 3 and 4) or when fresh (flasks 5 and 6). The results clearly suggest a marked lipolytic activity in this milk.

[2] Studies on lipase as affected by $CHCl_3$ subsequently undertaken and recently reported elsewhere (Jour. Am. Chem. Soc.) by the author show that $CHCl_3$ does retard the activity of lipase. These samples therefore would have shown a still higher initial acidity and greater development of acid had a better antiseptic, such as HCHO, been used.

Experiment 2. In this experiment the milk used was about forty-eight hours old when received. It was strongly rancid and bitter but had not been treated in any way previous to the beginning of the tests. The technic employed was the same as in experiment 1, except that a set of flasks was prepared for study in conjunction with the bitter milk, using fresh normal milk from the University herd. The following flasks were prepared:

Bitter milk

Flask 1. 50 cc. milk + 0.5 cc. $CHCl_3$.
Flask 2. 50 cc. milk + 0.06 cc. formalin.
Flask 3. Same as 1 except heated to 72°C. for thirty seconds.
Flask 4. Same as 2 except heated to 72°C. for thirty seconds.

Normal milk

Flask 5. 50 cc. milk + 0.5 cc. $CHCl_3$.
Flask 6. 50 cc. milk + 0.06 cc. formalin.
Flask 7. Same as 5 except heated to 72°C. for thirty seconds.
Flask 8. Same as 6 except heated to 72°C. for thirty seconds.

The results of this experiment are shown in table 2, and are summarized in table 3, the data being calculated in terms of 100 cc. of milk.

The data, like those obtained in experiment 1, show that the bitter, rancid milk of advanced lactation exhibits a pronounced lipolytic activity in comparison with normal milk and in comparison with the bitter milk which has been heated to the thermal death point of lipase. The activity of the lipase is seen to be decidedly greater in the presence of formaldehyde than in the presence of chloroform. This result is in conformity with those reported elsewhere by the author.[3]

It may be stated incidentally that the milk used in this experiment was employed also for one of the studies in which it was attempted, unsuccessfully, to transmit the bitter fermentation to normal milk by gross bacterial inoculation.

Experiment 3. In this experiment the milk used was only three or four hours old. It had a slightly bitter taste but the rancid odor had not yet developed.

The method of determining the activity of lipase in this milk was essentially the same as that used in the two preceding experiments but the technic employed was modified to secure the maximum results, in conformity with studies on lipase published elsewhere by the author (5).

The chief features of this technic are to use sufficiently large samples to permit the taking of aliquots for acidity determination and the use of alcoholic KOH and sufficient fat solvent to insure the determination of all the free fatty acids liberated in the hydrolysis.

TABLE 2

Lipolytic activity of bitter, rancid milk in comparison with normal milk, experiment 2

FLASK	INITIAL ACIDITY*	ACIDITY* AFTER 24 HOURS	ACIDITY* AFTER 48 HOURS
	cc.	cc.	cc.
1	31.84	10.00	4.20
2	38.40	14.44	9.60
3	29.35	3.58	2.30
4	27.30	3.00	2.00
5	23.30	4.48	2.60
6	30.00	4.56	6.10
7	23.10	4.80	2.80
8	29.12	3.60	2.80

* Cc. 0.1 N acid per 100 cc. milk.

TABLE 3

Summary of lipolytic activity of bitter milk, experiment 2

FLASK	ANTISEPTIC	0.1 N ACID DEVELOPED IN 100 CC. MILK	
		In 24 hours	In 48 hours
	Bitter milk		
		cc.	cc.
1	1 per cent $CHCl_3$	10.00	14.20
3	1 per cent $CHCl_3$ + heat	3.58	5.88
2	HCHO 1:2000	14.44	24.04
4	HCHO 1:2000 + heat	3.00	5.00
	Normal milk		
5	1 per cent $CHCl_3$	4.48	7.08
7	1 per cent $CHCl_3$ + heat	4.80	7.60
6	HCHO 1:2000	4.56	10.66
8	HCHO 1:2000 + heat	3.60	6.40

The following flasks were prepared:

Flasks 1 and 2. 150 cc. milk + HCHO, 1:1500.

Flasks 3. 225 cc. milk, heated in water bath at 63°C. for thirty minutes, cooled to 20°C., 100 cc. withdrawn, and HCHO 1:1500 added to remainder.

Flask 4. 225 cc. milk, heated to 72°C. for two minutes, cooled to 20°C., 100 cc. withdrawn, and HCHO 1:1500 added to remainder.

Flask 5. 225 cc. milk, heated just to boiling, cooled to 20°C., 100 cc. withdrawn, and HCHO 1:1500 added to remainder.

Flask 6. Portion withdrawn from flask 3.

Flask 7. Portion withdrawn from flask 4.

Flask 8. Portion withdrawn from flask 5.

Flasks 6, 7, and 8, which contained no antiseptic, were stoppered tightly with cotton and placed in the refrigerator at 10°C. to determine if rancidity would develop. Flasks 1 to 5 were used for the lipase determinations as follows: 25 cc. of the milk were withdrawn with a pipette, 1 cc. of saturated potassium oxalate added and the mixture brought to a faint pink with 0.1 N alcoholic KOH, using 5 drops of 1 per cent alcoholic

TABLE 4

Lipolytic activity of bitter, rancid milk, experiment 3

FLASK	TREATMENT	0.1 N ACID DEVELOPED IN 100 CC. MILK IN 24 HOURS
		cc.
1	HCHO 1:1500 only	23.77
2	HCHO 1:1500 only	24.76
3	Heated to 63°C. for 30 minutes + HCHO 1:1500	12.12
4	Heated to 72°C. for 2 minutes + HCHO 1:1500	1.70
5	Heated to boiling + HCHO 1:1500	0.23

phenolphthalein as indicator. One hundred cc. of neutral ethyl alchol and then 100 cc. of neutral ether were now added and after thorough shaking the mixture was again brought to a final end point with the alkali. Similar titrations were made on 25 cc. aliquots withdrawn after twenty-four hours' incubation at 37°C.

The results of these determinations are shown in table 4, the data secured being calculated to 100 cc. milk. Inspection of the table indicates clearly a marked acid fermentation in the case of the samples treated with formaldehyde, which was retarded appreciably when the milk was heated in accordance with the usual pasteurization temperatures and which was practically inhibited when the milk was heated to the thermal death point of lipase or above.

The examination of the portions of the heated samples placed in the refrigerator without addition of formaldehyde showed that samples 7

and 8 heated to 72°C. or above failed to develop the bitter flavor or rancid odor after forty-eight hours in the refrigerator, while sample 6, heated only to 63°C. developed these characteristics slightly after twenty-four hours and distinctly after forty-eight hours in the refrigerator. Even at this time, however, the condition of this sample was good in comparison with the remainder of the unheated samples 1 and 2 which had been incubated for twenty-four hours at 37°C. without any previous heat treatment. The odor of butyric acid was very strong in these samples.

DISCUSSION OF RESULTS

The so-called bitter milk of advanced lactation is probably not a matter of great practical importance. In view, however, of the evidence presented in this paper that an active lipase secreted in the milk is the cause of the difficulty, the possibility is suggested that the very rancid butter which one at times encounters, especially from the owners of only one or two cows, may be caused by a lipase of this origin. The author hopes to ascertain, when opportunity presents itself, how high a contamination of normal cream with cream from a cow giving milk of the character under discussion is required in order to affect seriously the market quality of the butter.

One of the features of the inquiries which are received in connection with bitter milk of physiological origin is how the milk in question can be made fit for use. In view of the fact that there is no reason to believe that such milk is unhealthful, the solution of this phase of the problem seems to lie in the success secured in the experiments reported above in preventing the development of the bitter, rancid characteristics by heating the milk to about 75°C. for a few minutes. This procedure should not impair the milk in any way for any of its normal uses, and, from the results obtained, should effectively prevent the development of the objectionable characteristics for the period during which the milk would ordinarily be kept.

CONCLUSIONS

Bitter milk of advanced lactation is caused by the secretion of an active lipase in the milk which hydrolyzes the milk fat quite rapidly, even at fairly low temperatures, with the libera-

tion of fatty acids among which are the lower, volatile fatty acids, especially butyric, which imparts, in large measure, the bitter flavor and rancid odor to the milk. The difficulty is not of bacterial origin. It can be effectively retarded, if not prevented entirely, by heating the fresh milk to 75°C. for a few minutes.

REFERENCES

(1) HARRISON, F. C.: Ontario Agr. Coll. Bul. 120, 1902. Earlier literature is here cited.
HUYGE, C.: Bul. Agr. (Brussels), xxii, 213–216, 1906.
WIEGMANN, H., GRUBER, T., AND HUSS, H.: Milchw. Zentralb., ii, 441–451, 1906.
WOLFF, A.: Milchw. Zentralb., v, 67–73. 1909.
SÖHGEN, N. L.: K. Akad. Wetensch. Amsterdam, Versl. Wis en Natuurk. Afdeel., xix, 689–703, 1910–11; Abstract in Exp. Sta. Rec., 1911.
(2) DUGGER, M.: Zeitschr. Gärungsphysiol., v, 321, 1916.
(3) ECKLES, C. H., AND SHAW, R. H.: U. S. Dept. of Agr. Bul. 155, 1913.
(4) PALMER, L. S.: J. Dairy Sci., v. No. 1, 51-62.
(5) PALMER, L. S.: Jour. Am. Chem. Soc. (in press).

THE EFFECT OF TEMPERATURE ON THE PERCENTAGE OF FAT IN MILK: A FIRST REPORT

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It is, in general, known that there is a relation between the time of the year, or season, and the percentage of fat in milk. Hills (1) studying the percentage of fat in milk during different periods of the year concludes, "that the tendency of a cow is to give from day to day richer milk when the temperature falls, and poorer as it rises," implying by this statement that temperature is the causative factor. Eckles (2) who found striking variations of the percentage of fat with season which is independent of the period of lactation or of the character of the diet suggests exercise and temperature as possible causes of this variation. Armsby (3) quotes Spier that between 41° and 53°F. temperature fluctuations have no appreciable effect on the percentage of fat. White and Judkins (4) have "no doubt that cold weather is a time for high tests, and warm weather for low ones." Clothier (5) apparently ignorant of Eckles' very important study in which the factor of variability of diet was eliminated, finds it "impossible to believe that the seasonal variation in butter fat content of milk observed in Arizona are not due directly to change of feed."

On a priori consideration, as judged by analogy from the profound influence of temperature on the life processes which have been studied (6) it would be predicted that temperature probably has a directing influence on the percentage of fat (as well as on the milk yield). The close association between season and temperature, and the known relation between season and the percentage of fat, as well as the finding of Hills (1) and the opinion of Eckles (2) that temperature may be responsible for the variations in fat, further encouraged the prediction, and made it seem decidedly worth while testing it out by direct observation between the fluctuation of the environmental temperature and fluctuation of the percentage of fat in the milk.

Accordingly, a group of ten cows at our disposal were set aside for a preliminary observation during the months of March and April of this year. All the conditions under control such as feed and exercise were kept approximately uniform throughout the period, the object being to record data showing the relation of temperature to the percentage of fat in milk uninfluenced, as far as possible under the usual conditions, by other factors. The

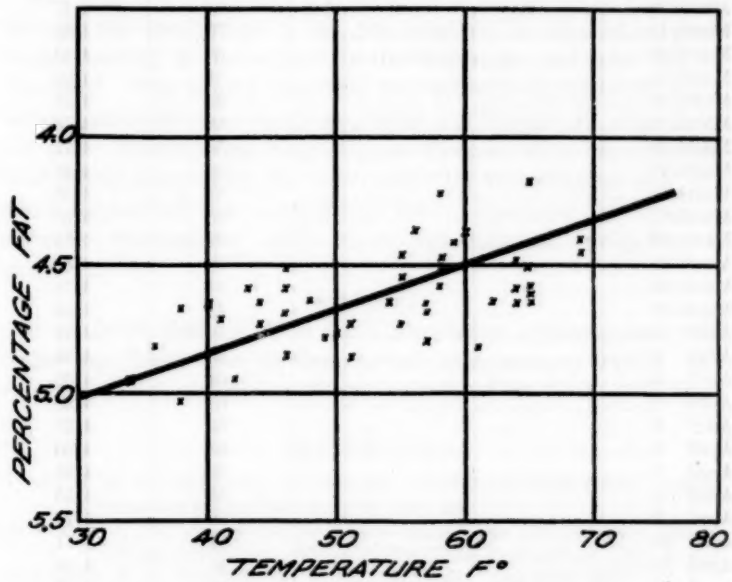

FIG. 1. THE VARIATION IN THE PERCENTAGE OF FAT IN MILK WITH TEMPERATURE.
Ordinates represent the percentage of fat; abscissae represent the environmental temperature in degrees Fahrenheit.

results shown in figure 1 and table 1 in which the average percentage of fat of the group for twenty-four hour periods is recorded against the average temperature of the corresponding twenty-four periods show fairly conclusively, as far as the preliminary experiment is concerned, that there is a relation between temperature and the percentage of fat showing roughly an increase of about 0.2 per cent in the fat for a decrease of 10°F. in

TABLE 1

DATE	MEAN TEMPERATURE FOR 24 HOURS	TRUE AVERAGE FOR 24 HOURS
		per cent
March 13	57	4.51
March 14	60	4.57
March 15	60	4.37
March 16	47	4.64
March 17	58	4.22
March 18	64	4.17
March 19	70	4.40
March 20	69	4.45
March 21	41	4.94
March 22	43	4.58
March 23	48	4.78
March 24	55	4.72
March 25	58	4.41
March 26	64	4.48
March 27	45	4.65
March 28	27	4.84
March 29	39	4.81
March 30	44	4.74
March 31	41	4.65
April 1	46	4.51
April 2	49	4.58
April 3	64	4.65
April 4	65	4.58
April 5	65	4.67
April 6	64	4.60
April 7	61	4.83
April 8	55	4.55
April 9	39	5.14
April 10	41	4.71
April 11	46	4.69
April 12	59	4.65
April 13	56	4.36
April 14	56	4.82
April 15	62	4.65
April 16	37	4.66
April 17	37	4.95
April 18	45	4.60
April 19	57	4.68
April 20	58	4.65
April 21	60	4.60
April 22	55	4.46

the temperature between the observed temperature limits. It is noted in this place that since the experiment was considered as preliminary it was thought permissible to record the percentage of fat against the outdoor temperature, though the animals were kept indoors during stormy days and cooler nights. The barn in which the animals were kept during these stormy and cold periods was well ventilated and not heated artificially.

The practical interest of a knowledge of the effect of temperature on the percentage of fat, for example in connection with official testing, is understood by the dairyman, and need not be discussed. The purely scientific interest will similarly be clear to one who looks over the monographs by Kanitz (6) and Rubner (6). Theories naturally suggest themselves on the possible mechanism connecting the environmental temperature and the percentage of fat, but it is perhaps best to postpone discussion of possible mechanisms until more experimental evidence is available.

SUMMARY

It is shown that all other conditions being approximately the same, the lower the environmental temperature within the observed limits, the higher the percentage of fat in cows' milk.

REFERENCES

(1) Hills, J. L.: University of Vermont Agricultural Experiment Station, Twentieth Annual Report, 1906–1907, 489.

(2) Eckles, C. H.: Jahreszeitliche Schwankungen des Prozentischen Fettgehaltes in Kuhmilch. Milchwirtschaftliches Zentralblatt, 1909, v, 488.

(3) Armsby, H. P.: The Nutrition of Farm Animals. New York, 1917.

(4) White, G. C. and Judkins, H. F.: Variations in the fat, solids not fat, and total solids in cows' milk. Storrs Agri. Exp. Station Bul. 94, 1918.

(5) Clothier, R. W.: Seasonal variation in butterfat content of milk in southern Arizona. Proceedings thirty-ninth annual meeting, Society for the Promotion of Agricultural Science.

(6) Kanitz, A.: Temperatur und Lebensvorgange. Berlin, 1915.

Rubner, M.: Die Gesetze des Energieverbrauchs dei der Ernäbrung, Leipsic, 1902.

Loeb, J.: The Organism as a Whole. New York, 1916, pp. 286–317.

BACTERIAL CONTENT OF MILK POWDER

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Research Laboratory, the Dry Milk Company, New York City

Aside from the attention which has been given to the question of whether or not living pathogenic bacteria, notably the tubercle organism, may be present in milk powder, there has been but comparatively little information recorded. The particular interest in the work reported by Delepine (1) is centered upon the results involving the virulence of the tubercle organism after being subjected to the temperatures of drying by the hot cylinder process. These results briefly indicate that the tubercle organism of bovine origin is rendered harmless after exposure to the temperatures used for desiccating milk by the Just hot cylinder process. In the same report references to other investigations are cited, the results from which seem to agree that infection by the tubercle organism from desiccated milk made by this process is highly improbable.

Other experiments carried out by Delepine (1) and others involve such matters as the survival of certain non-pathogenic bacteria; the number of bacteria in the powder immediately after drying; its subsequent contamination; and the longevity during storage of those normally present in the finished produce. The results of these experiments show that under normal conditions the number of bacteria per gram of powder as it leaves the drying cylinders is very low, usually only a few hundred, but that recontamination is easily brought about by subsequent handling. The extent of this recontamination under the conditions studied was sufficient to increase the bacterial content from a few hundred to several thousand per gram in many instances.

Downs (2) in an investigation as yet unpublished, found a wide variation in the number of bacteria per gram in milk powder

made by different methods as well as in individual samples from the same method. The average count of ten samples dried by a single roll process (modified Kunick process) in which the milk is previously condensed was 49,500 per gram, with a maximum count of 626,000 and a minimum count of 16,900; all counts except three were below 50,000. The average of ten samples dried by the spray process in which the milk is previously pasteurized and condensed was 178,000 per gram, with a maximum count of 595,000 and a minimum count of 15,600; four counts were below 50,000. The average of nine samples of spray process powder in which the milk is not previously condensed was 2,269,000 per gram, with a maximum count of 3,500,000 and a minimum count of 1,500,000. The counts of these powders were more uniform and much higher than the counts from any other samples thus far reported.

Studies on the types of microörganisms found in commercial milk powder reveal the presence of a large percentage of spore-producing bacteria of the *B. mesentericus* and of the *B. subtilis* types in practically all samples. White and orange coccus forms are also frequently found, as well as yeasts and a variety of molds. From the investigation reported by Delepine (1) it is concluded that the majority of the spore-bearing species survive the heat of the drying process, particularly in the case of the Just double roller process, and that the non-spore-bearing forms are present in the powder as the result of contamination after the powder leaves the drying cylinders.

EXPERIMENTAL

Although it is quite probable that the bacterial content of milk powder is not an important consideration in its sanitary and keeping qualities, it has, nevertheless, been desirable to obtain certain information upon which interpretations as to normal and abnormal conditions with respect to bacterial content of milk dried by the Just hot cylinder process, could be based. While part of the investigation recorded herein is similar in certain features to the work of another investigator to which

reference has already been made, its particular object was to secure data on the longevity of bacteria in milk powder containing various percentages of moisture.

The number and sources of bacteria in dried milk manufactured by the Just process

In order to ascertain the normal bacterial content of milk powder made by the Just process as soon as it is ready for the market, several samples, taken in such a manner as to be representative of the entire day's production, were obtained from different factories and analyzed as soon as possible—usually within one day after manufacture. The bacterial content of these fresh commercial powders is shown in table 1.

TABLE 1

Bacterial content of milk powder made by the Just double roller process

FACTORY	NUMBER OF SAMPLES	MAXIMUM COUNT	MINIMUM COUNT	AVERAGE COUNT
		bacteria per gram	*bacteria per gram*	*bacteria per gram*
1	10	10,000	700	4,600
2	26	170,000	2,000	27,300
3	34	96,000	700	18,800
4	13	37,000	800	5,000
5	28	6,360	350	1,500
6	22	8,600	2,100	3,400
7	25	1,400	400	790

The bacterial counts shown in table 1 from milk powders made by the same process at different factories are indicative of wide variations in bacterial quality of milk dried or in the extent of contamination subsequent to the actual drying process. In order to ascertain the extent to which these conclusions may be applicable, liquid milk with a normal flora but with wide variations in bacterial content was dried in the normal manner and the bacteria per gram of powder determined in samples of the dried solids taken immediately after leaving the drying cylinders thus avoiding all possibility of contamination by sifting, handling and packing. The results of these determinations given in table 2 show that the number of bacteria which survive the drying

process is very low, and that with liquid milk containing a normal flora, regardless of the number present, the number which survive is quite constant and does not bear any direct relationship to the number present in the liquid milk before drying. It would seem therefore, that the figures for the normal products (table 1) are largely due to recontamination after drying.

TABLE 2

Bacterial content of liquid milk and powder made from it

SAMPLE NUMBER	LIQUID MILK	POWDER FROM CYLINDER
	bacteria per cubic centimeter	*bacteria per gram*
1	2,750,000	270
2	12,000,000	550
3	147,000,000	600
4	280,000,000	880
5	345,000,000	520
6	1,520,000	520
7	2,300,000	500
8	3,100,000	200
9	1,700,000	1,350
10	2,100,000	220

TABLE 3

Bacterial contamination of milk powder after drying

SAMPLE NUMBER	MILK SOLIDS FROM CYLINDER	AFTER SIFTING	AFTER PACKING
	bacteria per gram	*bacteria per gram*	*bacteria per gram*
1	400	1400	2300
2	960	1400	2300
3	1100	3000	4300
4	600	2200	5200
5	290	1500	4100
6	540	1500	4000
7	50	300	500
Average.....	563	1614	3271

An illustration of the extent of contamination from the drying cylinders to the final package is shown by the results in table 3 in which is given the bacteria per gram of powder at the time the milk solids leave the drying cylinders, after sifting or bolting and after packing. These comparisons were carried out under practical routine factory conditions and illustrate the extent of re-

contamination as a factor in contributing to the total bacteria count of powders made by this process.

The extent to which recontamination can be controlled by proper precautions is well illustrated by the figures in table 4 which show the monthly average bacterial content of the product from one factory before and after thorough provision was made for reducing recontamination to the minimum.

It seems apparent that if the bacterial content of milk powder dried by the Just process is very high, it may be considered as an index of the degree of recontamination after the drying process itself is completed. This statement, however, does not

TABLE 4

Average count of daily samples of milk powder showing high efficiency in controlling bacterial content

MONTH	AVERAGE NUMBER BACTERIA PER GRAM
January	1785
February	1143
March	1195
April	800
May	650
June	405
July	590
August	584
September	595
October	600

apply with equal force to the powders made by the spray processes in which undoubtedly a greater number of organisms survive the drying temperatures.

Death-rate of bacteria in milk powder.

Even though the bacterial content of milk powder may be very high, any detrimental effect upon keeping quality is without doubt, eliminated because of the lack of sufficient moisture to allow multiplication. In fact there is every reason to believe that the bacteria which are present in the freshly made product die off rapidly during storage. Since there is no record of suffi

cient data from which a death-rate curve might be constructed, it has been considered desirable to obtain sufficient information for the completion of such a curve.

In order that the death-rate of the organisms in normal powder and in powder artificially inoculated, each with variable moisture content, might be determined, periodic examinations were made on a number of samples extending over a period of one year. Observations were also made to detect possible differences in keeping quality of those samples which were artificially inoculated to the extent of increasing the bacterial content far in excess of that normally found in commercial powders made by the Just process. Samples with variable moisture content were selected for the purpose of determining possible differences in death-rate in those powders containing moisture within the range of variation in this constituent which might possibly exist in the commercial product. Table 5 shows the bacterial content of several of these samples of powder determined immediately after manufacture and at two-month intervals for a period of one year. From these results it is apparent that a point of approximate constancy is reached after two to four months in samples having an initial count of 10,000 or less per gram, whereas a point of approximate constancy is not reached until after six months in the majority of samples originally containing over 10,000 per gram. The death-rate curves constructed from the average of all samples, from the average of samples with the least moisture content and from the average of samples with the highest moisture content are shown in charts A, B, and C, respectively.

The results from powder artificially inoculated are shown in table 6. These results are practically parallel to those from powders with a normal bacterial content in respect to death-rate in high and low moisture samples, although probably due to high initial count, the point of approximate constancy in numbers is not reached as quickly as in the normal samples. The death-rate curve constructed from the average of all samples is shown in chart D.

Examination of the samples recorded in tables 5 and 6 along with check samples containing the same amount of moisture

TABLE 5

Bacterial content of milk powder immediately after manufacture and after storage

SERIES	SAMPLE	MOISTURE	FRESH	2 MONTHS	4 MONTHS	6 MONTHS	8 MONTHS	10 MONTHS	12 MONTHS
		per cent							
I	1	3.16	3,200	500	400	400	300	300	200
	2	3.94	2,500	600	600	400	400	150	150
	3	5.13	3,300	450	350	350	400	300	200
	4	6.79	2,000	600	300	400	350	400	100
	5	9.34	2,500	1,100	300	400	200	200	100
II	1	3.60	22,000	9,200	1,000	850	150	200	250
	2	4.45	12,500	2,400	1,600	750	500	300	300
	3	5.69	20,000	3,200	2,000	650	350	250	250
	4	6.33	14,000	2,800	3,000	950	300	300	250
	5	9.01	15,000	1,600	700	800	200	300	350
III	1	2.00	750	900	300	350	150	150	200
	2	3.11	1,500	500	300	400	350	250	100
	3	5.05	60,000	55,000	25,000	2,000	350	100	100
	4	5.53	1,400	700	700	500	150	200	200
	5	6.29	100,000	42,000	4,000	900	250	200	50
IV	1	1.74	13,400	8,000	3,500	700	300	250	350
	2	2.72	62,000	15,000	3,500	600	300	300	300
	3	4.02	70,000	41,500	4,000	800	250	200	250
	4	4.33	62,000	15,500	3,000	1,600	350	300	400
	5	5.11	75,000	54,000	5,000	900	300	200	200
V	1	2.27	1,850	1,500	650	700	700	300	250
	2	3.74	17,500	14,000	1,000	400	500	500	400
	3	6.46	80,400	5,000	3,000	600	500	700	400
	4	7.17	75,000	1,000	350	400	500	500	200
	5	7.73	26,500	1,250	1,000	1,000	550	550	450
VI	1	1.91	1,300	500	650	700	700	500	500
	2	3.53	1,350	900	650	800	800	600	600
	3	4.31	2,200	900	900	900	900	550	400
	4	5.51	1,800	800	750	600	600	600	650
	5	6.22	4,200	800	700	700	700	800	550
VII	1	2.50	1,700	250	350	350	250	250	50
	2	4.15	1,100	100	300	300	200	400	50
	3	4.72	3,100	200	250	250	100	200	150
	4	5.20	1,600	200	300	400	300	150	100

TABLE 5—*Continued*

SERIES	SAMPLE	MOISTURE	FRESH	2 MONTHS	4 MONTHS	6 MONTHS	8 MONTHS	10 MONTHS	12 MONTHS
		per cent							
VIII	1	3.64	8,000	1,700	1,700	800	550	200	300
	2	4.92	6,000	650	500	300	450	550	150
	3	5.84	10,200	3,400	1,200	800	700	350	150
	4	6.41	32,000	12,500	2,000	900	850	600	300
	5	7.73	34,000	1,000	650	500	350	350	250
IX	1	3.01	20,000	15,000	15,000	750	350	350	
	2	4.85		5,000	5,500	450	450	450	
	3	5.14		6,000	6,000	400	400	400	
	4	6.76	50,000	8,000	4,000	500	450	500	
Average all samples		4.91	22,508	7,818	2,487	655	412	354	261
Average lowest moisture samples in each series.....		2.65	8,022	4,172	2,616	622	383	277	262
Average highest moisture samples in each series.....		7.04	34,533	12,216	1,850	677	366	361	256

TABLE 6

Bacterial content of milk powder after artificial inoculation and after storage

SAMPLE	MOISTURE	BACTERIA PER GRAM						
		Fresh	2 months	4 months	6 months	8 months	10 months	12 months
	per cent							
1	2.36	730,000	253,000	90,000	95,000	1,050	1,200	850
2	3.84	400,000	8,000	5,000	3,500	1,500	1,200	600
3	4.15	821,000	237,000	40,000	2,000	700	700	700
4	5.37	530,000	43,000	40,000	5,500	3,500	3,800	1,250
5	6.58	1,200,000	440,000	32,000	12,500	12,500	12,000	5,000
6	7.52	1,270,000	244,000	22,000	12,500	12,500	11,000	4,500
Average.....		825,000	201,000	38,000	21,800	5,300	5,000	2,100

but with only a few bacteria per gram did not reveal any differences in quality which could be interpreted as due to the presence of excessive numbers of bacteria.

CHART "A"
Death-rate of Bacteria in Milk Powder.
Average Moisture 4.01%

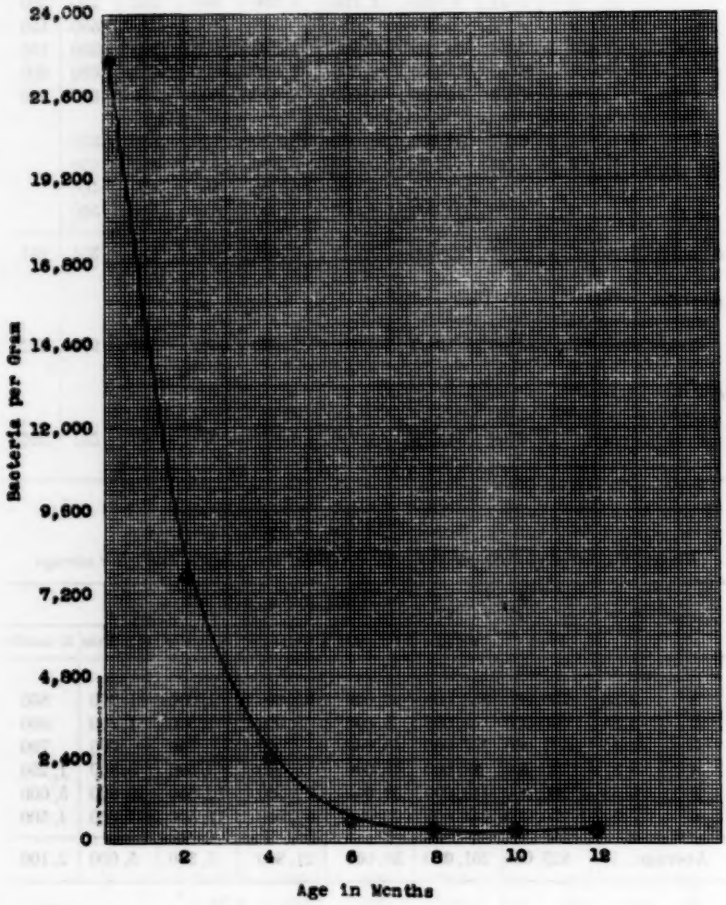


CHART "F"
Death-rate of Bacteria in Milk Powder
Average Moisture 2.65%

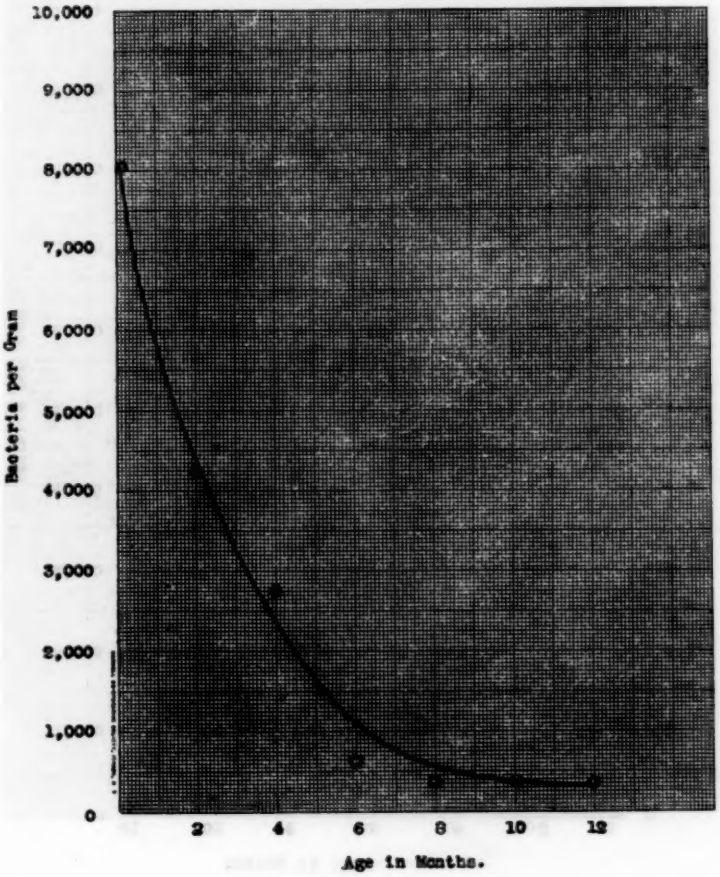


CHART "C"
Death-rate of Bacteria in Milk Powder
Average Moisture 7.04%

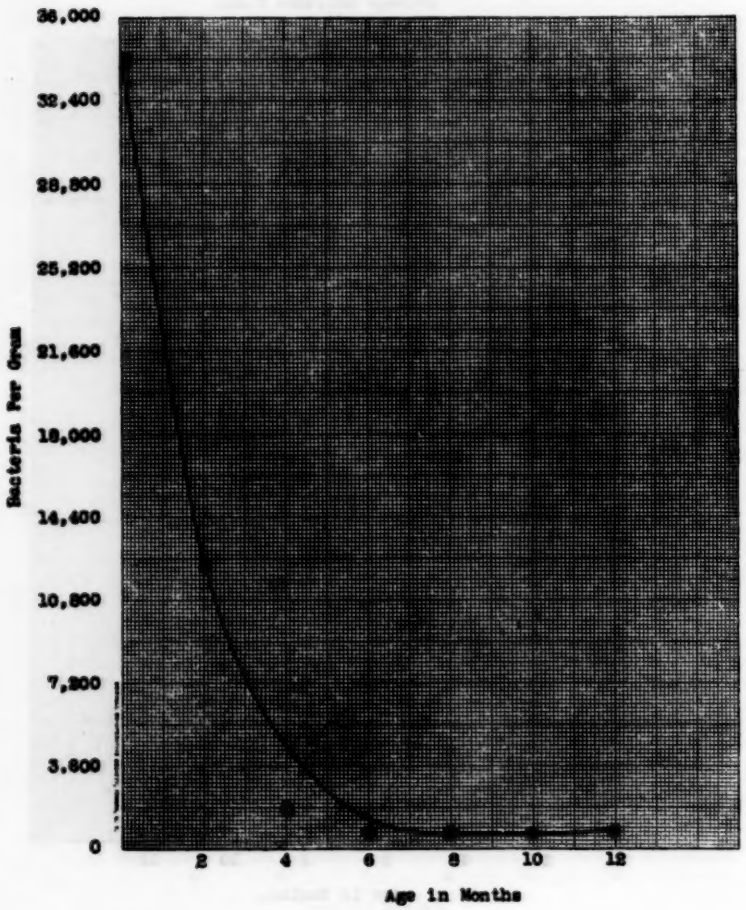
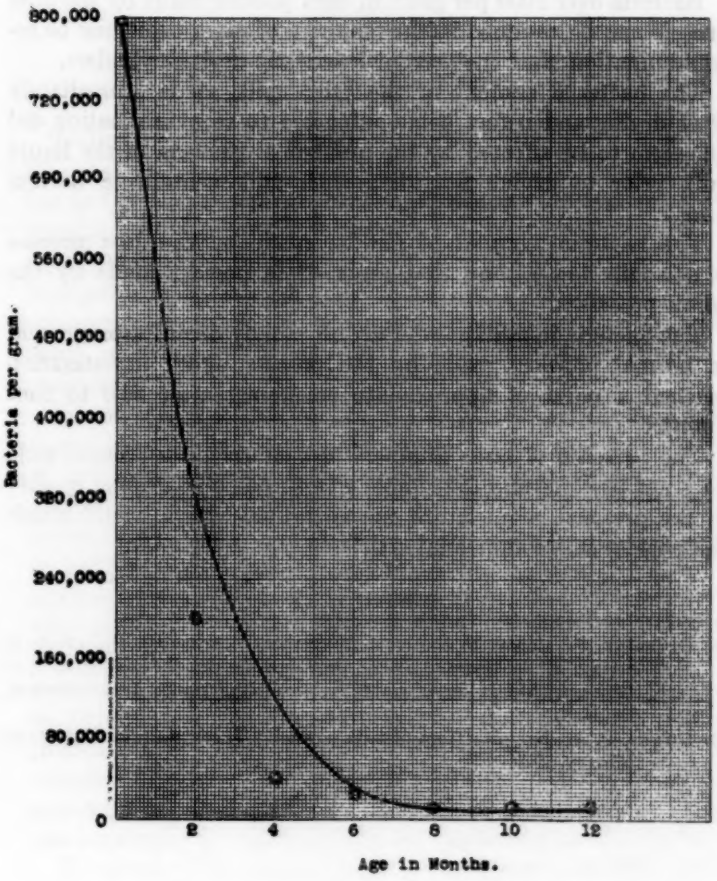


CHART "D"
Death-rate in Bacteria in Milk Powder
Artificially Inoculated.



CONCLUSIONS

From a review of the results recorded herein, the following conclusions may be drawn:

Bacteria over 1000 per gram in milk powder made by the Just process can be assumed in the majority of cases to be due to recontamination after the powder leaves the drying cylinders.

The bacterial content of the dried milk solids immediately after drying and before being subjected to recontamination did not seem to be affected by the number of bacteria in the liquid milk prior to drying providing such milk contains a normal flora.

The bacterial content of powder made by the Just process is normally lower than that reported in powder made by the spray processes.

The bacteria in milk powder die off rapidly during storage, and in normal powders made by the process under investigation reached a point of approximate constancy after two to four months.

The presence of large numbers of bacteria in desiccated milk does not produce any detectable effect upon the keeping quality in the presence of moisture concentrations which would admit the powder as a commercial article.

REFERENCES

(1) DELEPINE, S.: Report to the local government board upon the effects of certain condensing and drying processes used in the preservation of milk upon its bacterial contents. Food Reports 21, 1914. London, England.

(2) DOWNS, P. A.: Bacterial flora of milk powder. Thesis, Cornell University Library, 1920.

THE IMPROVEMENT OF QUALITY IN MILK THROUGH THE EFFORTS OF COLLEGE EXTENSION SERVICE

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To be most effective, agricultural extension service must solve the vital problems confronting the rural public. Methods leading to the solution of the various problems will necessarily vary because of different circumstances, but their ultimate effectiveness is measured by the extent to which agricultural practices are changed. Extension projects which yield results that can be measured and expressed in definite terms, carry greater weight than projects which do not lend themselves readily to measurement.

Certain types of extension projects are by nature more easily demonstrated than are others. Variety tests, and the influence of different fertilizers, are excellent illustrations of projects that yield results which may be tabulated or which may even be visible to the eye. This is, true only to a limited extent with reference to milk problems. It is easily possible to demonstrate the amounts of manufactured products made from milk of varying compositions, or to show the influence upon the temperature of different methods of cooling; but it is difficult to satisfactorily demonstrate such an abstract thing as quality in milk, except in research. Usually, however, such demonstrations are not practical nor workable from an extension point of view. The reason for this is largely due to the complications arising from the growth of microörganisms in milk, which introduces factors that are impossible to control under the conditions met in the field.

To mention the term "quality," as applied to milk, presupposed a definition of its meaning. Much space could be devoted to a discussion of the numerous factors involved, without even approximately settling the question. The factors that make up "quality" are complicated, and in general improvement in

quality has been retarded largely because of differences of opinion, making a common understanding impossible. While scientific circles have been debating as to what constitutes quality and as to means of controlling it, the consumer, the manufacturer, and the producer have been wrestling with the problem more or less aimlessly, because it was an immediate situation that had to be met in some way.

Just how the Extension Department could best help in bringing about actual improvement in quality, was a question difficult in itself to answer.

Since practically all changes in milk are the result of bacterial growth, it seemed that extension work which was designed to carry into the field knowledge concerning the relationship of bacteria to milk quality was the only really defensible procedure. Other factors that occasionally influence quality are not lost sight of; but the position is taken that the amount of milk which becomes undesirable because of these factors is relatively small, as compared to the amount that becomes undesirable through the accumulation of by-products resulting from bacterial action. If milk is produced and handled so as to keep the number of bacteria in it to a reasonable minimum, it must be agreed that there will, in general, be little reason for complaint against its quality.

The reducing of the number of bacteria necessarily involves the general question of bacterial "counts." The relative merits of different methods for making numerical estimates of bacteria will not be discussed here, further than to say that the differences between them are insignificant so far as the ultimate object—the improvement of milk quality—is concerned: nor will the use of bacteria "counts" as a means of expressing milk quality be discussed. There is much to be said on both sides of this question. The impelling reason for undertaking this project is the fact that thousands of dairymen in this state produce milk for fluid consumption in cities, and many of these cities have formulated ordinances enforcing numerical bacteriological standards.[1, 2]

[1] The Sanitary Code established by the Public Health Council of the State of New York. Chapter III. Milk and Cream. New York State Department of Health, Albany, N. Y.

[2] Sanitary Code governing the production, pasteurization, transportation, handling, storage, sale and distribution of milk and its products. Department of Health, 505 Pearl St., New York City.

Although these standards have been in force for many years, the majority of dairymen are still in ignorance regarding bacterial relationships. This is no reflection upon their intelligence, because very little has been done to bring to them concrete information along this line. There is little reason to believe that much improvement in quality can be hoped for, until the dairymen appreciate the fact that microörganisms in milk are actual, biological entities, rather than products of imagination, and, are largely responsible for the undesirable changes; and until they learn the common sources of contamination and the conditions that promote or retard bacterial growth. In fact, this is the general thought underlying the project which is outlined below and which is so organized, it is believed, that data collected can be summarized to show definite results.

County.....
Year.....

New York State College of Agriculture — Department of Dairy Industry
Sub-Project No. 1 — Extension Project No. 16

LEADERS: J. D. Brew, W. E. Ayres

OBJECT: To instruct the producers of milk concerning the sources and growth of bacteria and their relationship to the quality of milk; to assist in locating at any plant the principal causes for inferior quality; and to assist the producers in fulfilling the bacterial requirements for the various grades and for premiums.

PROCEDURE: This sub-project is to be conducted at any fluid milk plant or at any plant where milk products are manufactured. The work consists in grading the milk microscopically, according to the number of bacteria in it. In general the country grades established by the New York City Board of Health will be followed. The grades are as follows:

G = Good—qualifies for pasteurization as Grade A so far as number of bacteria is concerned. Less than 100,000 per cc.

Satis. = Satisfactory—qualifies for pasteurization as Grade B so far as number of bacteria is concerned. Less than 300,000 per cc.

Poor = Milk having a count greater than 300,000 per cc.

The milk delivered by each patron should be graded on at least two consecutive days and the results presented to the patrons at a meeting which has been previously scheduled, together with a discussion of the sources of bacteria and their growth. In order to ascertain whether or not any improvement in the quality of the milk resulted, it is necessary to regrade after the meeting. This may be done immediately following the meeting, or, if more convenient, at some later date. If the regrading is done immediately after, it is advisable to spend four days at the plant, especially if much of the milk is Poor in quality. If the quality is uniformly Good, it is unnecessary to

spend more than two days, or three at the most, in the community. A good idea is to plan work at two plants during the same week, and the entire project will be more satisfactory if, for instance, the milk at plant A is graded on Monday and Tuesday, with a meeting of the patrons on Tuesday evening, and the milk at plant B on Wednesday and Thursday, with a meeting on Thursday evening. Then return to plant A to regrade and check results on Friday, and to plant B on Saturday. This gives the dairymen at each plant an extra day in which to carry out the recommendations.

Personal visits to those farms from which inferior milk is being delivered will accomplish much in some cases.

COÖPERATION: The county agent will select the plants and make all necessary arrangements. There should be a real need for the work, which should be thoroughly appreciated by all parties concerned. The coöperation and interest of the patrons and the plant managers is essential. It is imperative that the patrons be acquainted beforehand with the purpose of the work, in order that they do not gain the impression that it is a mere inspection. To regard it as an inspection is a source of embarrassment and makes the benefits derived questionable. It is not necessary, however, to advertise the exact days in which the work is to be done.

The county agent should furnish the Extension Department with information concerning the following points: Type and name of plant, number of patrons, name of manager or superintendent, grade of milk handled, whether the grades are based on barn score or bacteria counts, whether or not premiums are paid, if a fluid milk plant the city in which the milk is sold, and the time at which the first patrons arrive in the morning.

EXPENSES: All necessary apparatus will be furnished by the Department of Dairy Industry. Local transportation will be furnished by the county agent. Other traveling expenses will be shared between the College and the Farm Bureau on the zone system.

This work had its beginning early in March, 1921, at a grade B pasteurizing plant, located in St. Lawrence County, from which milk was being shipped to New York City. Notice had been served upon the owners of this plant by the City Board of Health, to the effect that, because of too high bacteria counts in the milk at the time of delivery in New York, the milk would be excluded from the city if conditions were not improved within a certain specified time. This threat of rejection caused the owners and the patrons no small concern, because, if carried out, it would mean a serious financial loss to all. No one can, in justice, question the right of any city to enforce reasonable measures to safeguard its milk supply. However, when such notices are served, the management of most milk plants are invariably confronted with an almost impossible situation due to the fact that no one

knows where the trouble lies. It was to locate the source of the trouble that the College was called upon for assistance by the patrons, through the County Farm Bureau Manager.

The milk delivered by each patron was graded microscopically (1) on three successive days (March 7, 8, and 9), according to the procedure outlined. Grading on successive days gives more exact information as to the patrons delivering inferior milk, and also gives an impression of thoroughness which does much to stimulate the interest of the patrons in the entire project. Furthermore, it enables one to observe the plant operations more closely, because it may be that the cause of the trouble will be found in faulty plant methods, rather than in the quality of the milk

TABLE 1

The results of preliminary grading previous to meeting of patrons

DATE	NUMBER OF SAMPLES GRADED EACH DAY	NUMBER OF SAMPLES RATING AS		
		Good*	Satisfactory*	Poor*
March 7	72	56	5	12
March 8	80	63	6	11
March 9	85	65	5	14

* The terms *Good*, *Satisfactory*, and *Poor* are used because, under the conditions in New York State, they seem to better express to the patrons the quality of milk as regards meeting the bacterial requirements for Grade *A* or *B*. There is no thought of advocating their use to displace any of the present systems for designating or naming grades.

delivered by the dairymen. At a meeting of the patrons, the results of the grading were placed on a blackboard, as shown in table 1. The sources, growth, and control of bacteria were taken up in discussion.

The meeting was attended by one hundred and thirty persons, although there were only eighty-two patrons. One striking point brought out was the fact that a relatively large amount of Good milk was being delivered daily by the same patrons, and, for the most part, the Poor milk also was delivered by the same patrons. The bacteria count in much of the latter was so high as to jeopardize the whole supply after mixing. The large number of patrons delivering Good milk made a profound impression

and left no argument for the deliverers of Poor milk. The patrons demanded that the supply be graded later, to ascertain whether or not any improvement had taken place. This was done on March 30 and 31, but care was taken this time not to inform the patrons of the exact date. The results are shown in table 2.

The extent of the improvement can best be shown by giving in table 3 the percentage of the total number of samples that rated as Good, Satisfactory, or Poor before and after the meeting.

TABLE 2

Results of grading after meeting of patrons

DATE	NUMBER OF SAMPLES GRADED EACH DAY	NUMBER OF SAMPLES RATING AS		
		Good	Satisfactory	Poor
March 30	89	79	5	5
March 31	88	77	5	6

TABLE 3

Percentage rating according to grade

DATE	TOTAL NUMBER OF SAMPLES IN EACH GRADING	PERCENTAGE OF SAMPLES RATING AS			NOTES
		Good	Satisfactory	Poor	
March 7, 8 and 9	237	77.6	6.8	15.8	Before meeting
March 30 and 31	177	88.1	5.6	6.2	After meeting

The patrons asked for another meeting, which was held on the thirty-first with an attendance of one hundred and forty. The question of bacterial relationships was further discussed, and the patrons took full advantage of the opportunity offered to talk over frankly many of their own individual problems and experiences and to ask questions aiming to clear up some of the doubts in their minds. This is a most valuable part of any meeting.

The second grading revealed another interesting bit of information that greatly impressed the patrons. This was the marked decrease in the number of bacteria in the mixed milk from the vat after efforts had been made to improve the care and handling on the farm. On March 8 and 9, the count on the mixed milk

each day was 260,000 and 430,000 per cubic centimeter, respectively, but on March 30 and 31, the count was 80,000 and 140,000 per cubic centimeter, respectively.

The results of this first attempt to find out why a given supply of milk is high in bacterial content, and to carry to the producer information regarding the bacteriology of milk, exceeded expectations, and there has since been a large demand for similar work elsewhere. Fifteen plants in all have been studied, and many interesting facts could be presented if there were space to summarize and discuss separately, the results obtained at each. Practically all types of fluid milk plants were represented, including grade A plants at which premiums were paid for all milk delivered with a bacteria count, averaging under 10,000 per cubic centimeter, and plants where there was no effective control over quality and no particular stimulus to produce a better grade of milk. The general conditions surrounding one plant were quite different from those of another, and consequently the results obtained would naturally vary. The work at several of these plants yielded results as satisfactory and as encouraging as those obtained at the first plant. At two plants, however, the results were somewhat disappointing, although this fact occasioned no surprise because the patrons evidenced no particular interest in milk quality. There was no special incentive.

The summarized results obtained from the work done at all of the plants, together with the percentage of the total number of samples that rated as Good, Satisfactory, or Poor, are given in table 4.

The summary in this table represents forty-six days of work. In all, 3243 samples were graded, of which 64.5 per cent rated Good, 10 per cent Satisfactory, and 25.5 per cent Poor. The 3243 samples were taken from milk delivered by 1104 patrons. The total number of contacts at all of the eighteen meetings was 1056, which, if compared to the number of patrons, is nearly 100 per cent. This is somewhat misleading because at each of three plants an extra meeting was held at the request of the patrons. The average attendance was 58.7, the largest being 140 and the smallest 8. The average number of patrons at each plant was 61.3, the largest being 196 and the smallest 31.

At ten of the fifteen plants, data were obtained to determine whether or not any improvement resulted after placing the situation frankly before the patrons. Wherever possible, it is advisable to do this. Occasionally, however, the circumstances will be such that nothing particular is to be gained; such, for instance, as lack of interest, or time, or, as at one plant, when the milk delivered rated 97 per cent Good and a regrading would very likely be merely a repetition of results. The summary of the ten plants is given in table 5.

TABLE 4

Rating of all samples taken at fifteen plants

TOTAL NUMBER OF SAMPLES GRADED	NUMBER OF TOTAL RATING AS		
	Good	Satisfactory	Poor
3,243	2,088	327	828
Per cent.....	64.5	10	25.5

TABLE 5

Grading of all samples at ten plants before and after meeting of patrons

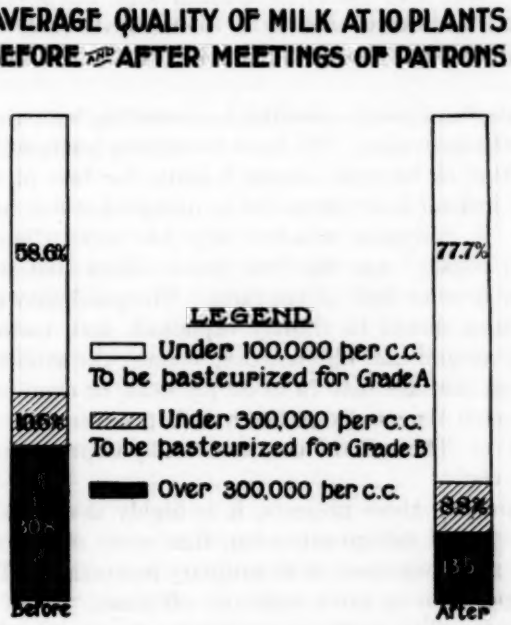
TOTAL NUMBER OF SAMPLES*	NUMBER OF TOTAL RATING AS						NOTES
	Good		Satisfactory		Poor		
		per cent		*per cent*		*per cent*	
1,446	847	58.6	153	10.6	446	30.8	Before meeting
1,097	852	77.7	97	8.8	148	13.5	After meeting

* Usually two days grading before meeting and one after.

The actual improvement may be shown more clearly in the accompanying graph.

Time, expense, and labor are important elements in conducting milk quality projects. The effectiveness of a project is very likely to be lost if either of these are unduly increased. It is highly desirable that all of the milk delivered be sampled and examined on the same day. To take part on one day and part on another, may yield results that are difficult to interpret because the conditions may not be comparable. Marked changes in outdoor temperature, for instance, influence the bacterial content.

The average fluid milk plant in New York State has from 50 to 150 patrons. With the direct miscroscopic method, the application of which will be described in a subsequent publication, it is possible in many plants for one man to take, prepare, and examine as many as 150 samples in one day. Ordinarily the examinations are completed early enough in the afternoon to make it possible to visit dairies from which Poor milk is being



delivered and also to inform any patron if he wishes to know how his milk is graded. It occasionally happens that some patron would like to try a change in methods to see what the influence would be. For example, one patron placed two cans of night's milk in cold running water at 35° and two other cans were allowed to cool in the open air, which on this particular night was freezing point. On the following morning the count of the first two cans was 10,000 and of the last two, 900,000 bacteria per cubic centimeter

The temperature of the latter was 60° when delivered and that of the former 35°. This patron told at the meeting exactly what he had done, and there is no question that this in itself, did more to drive home the importance of prompt cooling than anything the speaker could have said.

There may be some justifiable doubts as to the advisability of making such experiments as this in the field. The writer at first proceeded with considerable misgivings, but several similiar experiences have been such as to demonstrate their value. On more than one occasion a certain point has been clearly shown in this way.

Absolute frankness is essential in presenting bacterial relationships to the dairymen. We have heretofore hesitated to discuss the question of bacteria counts frankly, for fear of misleading him, and instead have succeeded in doing what was hoped to be avoided. A dairyman wonders why his count "jumped from 40,000 to 50,000," and has been led to think that it was very likely due to some fault at the farm. The possibility and causes of variations should be frankly explained, and, instead of emphasizing insignificant differences in counts, the attention should be fixed on the fact that 75 or 80 per cent, or even more, of all the dairymen repeatedly produce milk good enough to qualify for grade A. This will do more to actually improve quality than anything else.

In organizing these projects, it is highly desirable, from the point of view of college extension, that every effort be made to eliminate all appearances of an ordinary inspection. The motive of an inspector is to catch some one off guard. This the dairyman resents. The motive underlying extension work with reference to milk problems is purely educational. The success of the project depends upon winning the confidence and the coöperation of every individual concerned. The object is to get at the facts leading to the elimination of all faults responsible for Poor milk, and thereby to ward off permanently the danger that a given milk supply will not meet the requirements of the Board of Health, or the possibility of the failure of the patrons to draw premiums or to meet other requirements related to quality.

To retain the confidence of all concerned (and that of the dairymen is particularly vital), the results obtained should never be used by an organization as a basis for rejection. It should be distinctly understood that any rejections following the project should be based upon data secured afterward by the organization itself. This plan can be quite satisfactorily carried out if all projects are organized, or at least sanctioned, by the County Farm Bureau.

In order to insure the most satisfactory results, it appears that some kind of stimulus is essential. Those dairymen who have the opportunity to draw premiums, or who sell to plants that are compelled to meet certain bacteriological requirements or where they feel that the bacteria counts made by the commercial company have not been fair, will be most interested in such projects conducted by the College. Absence of any stimulus whatever invariably means almost a total lack of interest.

In presenting and discussing the data contained in this paper, it is not assumed that the lowering of 30.8 per cent Poor to 13.5 per cent means that his improvement will necessarily be permanent. A 100 per cent perfection is practically impossible. The improvement of milk is primarily an educational project, plus some compelling force such as a financial stimulus or rejection of milk Poor in quality. Any change takes place slowly. The writer would not be surprised, for instance, to find at the place of the first project that the 6.2 per cent Poor on March 31 was somewhat higher, due to changes in patrons, or perhaps to a failure on the part of the plant management to enforce requirements, or to other factors. But there is good reason to believe that the general quality of this particular milk supply has been improved, because the procedure as outlined is an excellent way in which to carry to the patrons the message of the relationship between the bacteria content of milk and its quality.

REFERENCES

(1) BREED, R. S., AND BREW, J. D.: Counting bacteria by means of the microscope. N. Y. Agr. Exp. Station Tech. Bul. 49, 1916.

STRUCTURE OF POWDERED MILK AND ITS POSSIBLE RELATION TO THE KEEPING QUALITY OF WHOLE MILK POWDERS[1]

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In the course of our investigations of certain chemical and physical properties of remade milks reported in the preceding paper, considerable difference was noted in the keeping quality of the whole milk powders used for reforming the fluid milks. The outstanding features of these observations were, first, that the predominating type of deterioration was a strong tallowy odor, and second, that this type of deterioration was confined to the spray process powders during the extent of the investigations (eleven months).

Coutts (1) has observed that whole milk powders deteriorate with age and that this is especially true of the whole milk powders made by the spray method. This investigator expressed the belief that oxidation of the fat is the cause of this deterioration. This harmonizes completely with the typical tallowy odor which we found developed in the spray powders, inasmuch as the tallowy decomposition of butter fat has been shown by Hunziker and Hosman (2) to be an oxidation reaction. It may be mentioned in this connection that the term rancidity is frequently applied to all types of fat deteriorations whereas it should, in the writer's opinion, be limited, in the case of butter

[1] Published with the approval of the Director as Paper No. 284, Journal Series, Minnesota Agricultural Experiment Station. The material presented in this paper forms a part of the thesis of C. D. Dahle, submitted in partial fulfillment of the requirements for the degree of Master of Science, in the Graduate School of the University of Minnesota, 1921.

fat, at least, to hydrolytic decompositions which result in the liberation of butyric and other volatile acids. Guthrie (3) has expressed this view also. Rancidity, in this sense, is not a common type of deterioration of whole milk powders, although it was noticed in a few cases with certain samples of centrifugal spray whole milk powder.

The fact that our samples of whole milk powders developed tallowiness on standing was confirmed in a chemical way by applying the test for "rancidity" worked out by Kreis (4). While this test is designated by Kreis as a test for rancidity, it is in reality a test for oxidation as Kerr (4) has pointed out. We applied this test to the fat secured from both centrifugal and pressure spray powders six to nine months old with positive results, the same test applied to fat from the drum process powders of the same age being negative.

No explanation has been advanced, so far as the authors are aware, of the difference in keeping quality of whole milk powders made by the spray and drum processes, which manifests itself in the production of tallowiness in the case of the former type of powder. Certain observations which the authors made on the structure of whole milk powders seem to offer a partial explanation, at least, for this difference.

It has been observed by others (1) that milk powders made by the spray process consist of microscopic granules which are spherical in shape. The authors found this to be true for both the pressure and centrifugal spray powders although the granules are considerably smaller in the former case than in the latter. Powder made by the drum process, however, consists of irregular platelets, as would be expected from the method of drying.

The significant feature of the structure of the spray process powders, however, is the fact that practically all the granules contain a spherical core of air, which does not appear at all in the case of the drum powders. This air cell is not discernible when the dry powder granules are observed under the microscope. However, if a drop of water is placed on the powder and the moistened powder observed, the protein material in the granules swells and becomes more or less transparent before disintegrating

and the core of air becomes plainly visible. At times the microscopic air bubbles will float around in the water like miniature ballons after the protein and fat have dissolved away. Again, the air cell will burst before the milk powder adhering to it has dissolved away, sending a shower of fat globules in all directions.

When one hinders the solution of the milk granule by chemical treatment, e.g., hardening in very dilute formalin, the swollen particle presents a very pretty picture showing the central spherical air cell surrounded by the dried serum solids in which are imbedded the globules of milk fat. If the fat globules have been stained with a fat dye[2] like Sudan III previous to the treatment with water, the picture presented is a very striking one. Figure 1 in the accompanying plate shows a photomicrograph[3] of centrifugal spray powder after staining the fat globules and swelling the partially hardened particles. The core of air as well as the fat globules are plainly visible.

One noticeable difference between the centrifugal and pressure spray powders is in the relative size of the air cell in the granules. We observed that it usually forms a much smaller proportion of the total granule in the case of the pressure spray powder and was, at times, absent altogether. Several hours heating of this powder at 100°C. also caused the air to disappear. It was found more difficult to photograph the pressure spray powder granules to show the fat globules and the air cell because of the fact that the milk fat is homogenized in the process of manufacture, and also because it was harder to control the disintegration of the granules. Figure 2 shows a fairly successful attempt to obtain the picture of the disintegrating pressure spray powder granules showing the fat globules and some air cells. Figure 3 shows flakes of drum process powder after staining the fat globules.

[2] We found the simplest method of staining the fat was to dust a little powder into 60 per cent acetone and allow it to remain for a few minutes to partially coagulate the proteins. A few drops of N/50 HCl and a few drops of saturated acetone solution of Sudan III were added, the acid greatly increasing the intensity of staining. This mixture was allowed to stand a few minutes and the stained powder then washed by decantation using 20 per cent acetone.

[3] Photomicrographs were made on Wratten and Wainwright's panchromatic "M" plates, using ray filters for contrast and detail.

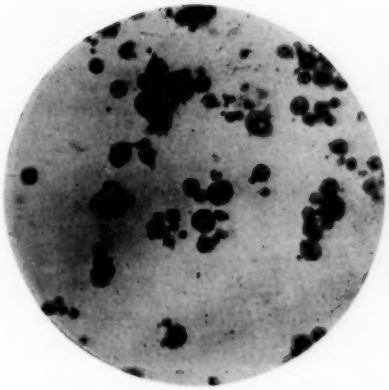

FIG. 1. Photomicrograph of hydrated centrifugal-spray whole milk powder granules, showing fat globules and central core of air. D × 170. (Cut reduced one-third.)

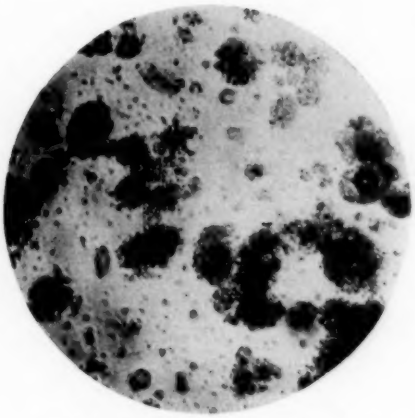

FIG. 2. Photomicrograph of hydrated pressure-spray whole milk powder granules, showing fat globules and central core of air. D × 330. (Cut reduced one-third.)

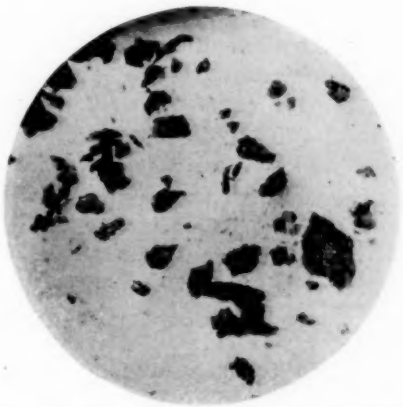

FIG. 3. Photomicrograph of hydrated drum process milk powder, from partially skimmed milk, showing fat globules and absence of air from powder grains. D × 170. (Cut reduced one-third.)

The low solubility of this powder in water does away with the necessity of hardening the flakes to prevent their rapid dissolution.

The tension which exists at the surface of the air cell and the surrounding membrane of proteins is surprisingly great. It was found that simple grinding in a mortar has no effect on it. Several hours' grinding in a ball mill was found necessary in order to break this tension and destroy the air cell.

We are unable to offer any adequate explanation for the interesting structure of the spray powders which we observe. Griebel (5) mentions having seen a milk powder full of air, his description resembling somewhat the one which is given in this paper. The cause of the air cell is evidently related to the fact that the milk is dried very rapidly in a large volume of air. It is possible, also, that a considerable amount of air is incorporated in the milk at some step in the process. The general picture of the dried particles, at least, suggests strongly the drying of a very fine foam.

The bearing of the structure of the spray process whole milk powders upon their inferior keeping quality, and their tendency to become tallowy, i.e., oxidize, is at once apparent. The fat is exposed not only to the air on the outside of the granules, which can be eliminated to a certain extent by packing, but also to air within the granules, with cannot be eliminated except by mechanical means or heat, both of which destroy certain desirable features of the powders. The fact that the pressure spray powders contain less air than the centrifugal spray powders is offset by the fact that the homogenized fat in the former presents a much greater surface for the action of the air. Whether the process of manufacture can be modified so as to prevent the incorporation of air within the granules, must be worked out in the factories.

It is well to bear in mind that the evidence that the structure of the milk powder particles has a bearing on their keeping quality is at present only circumstantial. We are engaged in submitting this hypothesis to experimental study and will report our findings in a later publication.

SUMMARY

The structure of whole milk powders made by the spray and drum methods is described. It is suggested that the presence of air within the granules of powder made by the spray process has an important bearing on the fact that this type of whole milk powder is especially prone to undergo tallowy, i.e., oxidative, deterioration.

REFERENCES

(1) COUTTS, F. J. H.: Reports to the Local Government Board on Public Health, etc., N. S. 116, Food Reports No. 24, 1920.
(2) HUNZIKER, O. F., AND HOSMAN, D. F.: Jour. Dairy Science, v, 320, 1917.
(3) GUTHRIE, E. S.: Jour. Dairy Sci., v, 218, 1917.
(4) KREIS, —: Verhandl. Naturf. Gesell. Basel, xv, 225, 1903–4; cited by KERR, R. H.: Jour. Ind. Eng. Chem., x, 471, 1918.
(5) GRIEBEL, C.: Zeit. Nahr. Genussm., xxxi, 246, 1916.

DAIRY NOTES

DAIRY DIVISION, B. A. I., UNITED STATES DEPARTMENT OF AGRICULTURE. Edwin H. Daane, a graduate of the University of Wisconsin, who specialized in dairy manufacturing, has been appointed for experimental cheese investigations, in the Dairy Division.

Henry B. Lowe, a graduate of Dartmough College, who has taken graduate work at Columbia University, has been appointed for chemical investigations of dairy by-products (milk powder, etc.) Mr. Lowe has had several years' experience in commercial chemical plants before coming to the Department of Agriculture.

NEBRASKA UNIVERSITY. Mr. Benjamin Masurovsky, a graduate of the New Jersey Agricultural College, who has pursued graduate work at Columbia University and the University of California, joined the staff of the Dairy Husbandry Department of the University of Nebraska on January 1, 1922, as a graduate assistant. Mr. Masurovsky will assist in the research work of the department and will pursue his studies toward his doctorate degree.

WISCONSIN. At the October meeting of the Wisconsin branch of the Society of American Bacteriologists, Dean H. L. Russell was presented by his former students with a volume entitled "Papers on Bacteriology and Allied Subjects." This appreciated memorial was given in commemoration of the twenty-fifth anniversary of his doctorate. The real anniversary day occurred several years ago, but due to the war conditions immediately following, the publication of the volume was delayed.

It is a most comprehensive volume containing contributions from thirteen of the leading bacteriologists who were among the early students of Dr. Russell. E. G. Hastings of the University of Wisconsin reviews the Dean's scientific career and points out the strategic opportunities presented to pioneer bacteriologists. Dr. Russell was the first full-time agricultural bacteriologist in America. He was likewise one of the first men to be employed in this country to teach and do research work in bacteriology outside of the medical school. His scientific

papers, books, and bulletins, number well over one hundred and twenty-five and are of fundamental importance.

A development of the city milk supply problems is the contribution of H. A. Harding, formerly of the University of Illinois. He states the problems past and present in an interesting way and concludes by saying of Dr. Russell, "This Pioneer Bacteriologist in person and through his students has taken an honorable part in the solution of these problems."

That the greater prevalence of mold spores over bacteria in the air is due to the fact that most bacteria are readily killed by the sun's rays while mold spores are only slightly affected is the conclusion reached by John Weinzirl of Washington State University in his treatise on the resistance of mold spores to sunlight.

In a series of experiments carried on at the University of Minnesota, C. H. Eckles found that the percentage of fat in milk could be markedly increased for the first twenty to thirty days when it is followed by underfeeding during the period of lactation. Underfeeding of the cow must be taken into consideration in the interpretation of data involving variation in the composition of milk and butter fat.

L. A. Rogers, chief of the dairy division of the United States Department of Agriculture, summarizes the work done in his department on the characteristics of the Colon-Aerogenes group of bacteria. He regards B. coli and B. aerogenes as very distinct types. He discusses the taxonomic position of other members of this group in relation to these two varieties.

D. J. Davis of the medical school of the University of Illinois, presents evidence and argues convincingly to show that the fungus which causes sporotrichosis disease affecting both man and horses and common in France and occasionally in America, is identically the same species and should be called by the name first used by Hektoen in this country.

A butter having only a few yeasts and molds, when other conditions are favorable is a safer hazard for shipments and storage is the claim of F. W. Bouska and J. C. Brown of Chicago in their paper on "Yeasts and Oidia in Pasteurized Butter." Creameries which have the best commercial reputation for their butter also have the lowest yeast and mold counts. These two men give methods for sampling and counting butter which they have recently devised.

The late Dr. Edw. Birge presented his study on the activities of certain bacteria in sewage. He believed that some bacterial forms can

be found which will play an important rôle in the treatment of sewage, and that the time will come when septic tanks will be seeded as alfalfa fields and cream vats are seeded now.

A method for the detection of pasteurized milks is described in detail by Dr. W. D. Frost of the University of Wisconsin. The addition of a special dye stains the blood cells, always present in pasteurized milks. In raw milks the cells will not be stained.

A strong plea for the thorough investigation of all waters whose potability are questioned, and for thoroughly trained investigators experienced in laboratory and field work, is put forth by H. A. Whittaker of the University of Minnesota in a paper on the "Invesitgation of Drinking Water Supplies."

A. L. Amott, a commercial milk expert in Chicago has given much time, energy and thought to "The Milk Supply of Chicago," and discusses the source of supply, amount, production, transportation, city distribution, prices, farmers' organizations, and milk inspection. He calls attention to the improvement of the milk supply and the lowered baby death rate in recent years in Chicago.

B. W. Hammer of the Iowa Agricultural College in a paper on "The Bacteriology of Ice Cream" summarizes the knowledge of such points as number and kinds of bacteria, sources of materials, effect on the bacteria during freezing, hardening and holding, softening and rehardening. He also treats of the manufacture of ice cream with a low bacterial count, and the relation of ice cream to the public health, and bacterial standards.

J. H. F.

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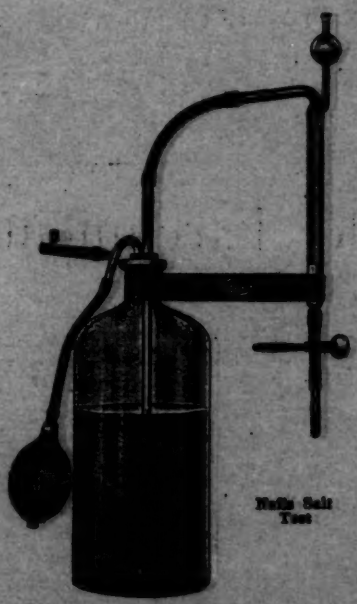
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